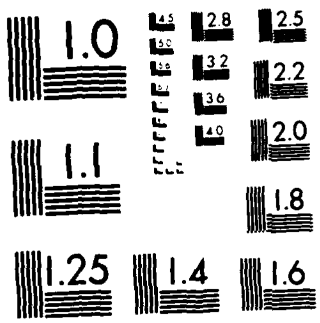
AD-A126 678 PRODUCT ASSURANCE REQUIREMENTS GUIDE FOR NAVAL OCEAN SYSTEMS CENTER PROJECTS(U) NAVAL OCEAN SYSTEMS CENTER SAN DIEGO CA 21 DEC 82 NOSC/TD-432 1/5

UNCLASSIFIED F/G 5/1 NL


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

-AD A 126 678-

(13)

NOSC TD 432

NOSC TD 432

Technical Document 432

PRODUCT ASSURANCE REQUIREMENTS GUIDE FOR NAVAL OCEAN SYSTEMS CENTER PROJECTS

Product Assurance Division
Code 931

21 December 1982

Approved for public release; distribution unlimited

NOSC

NAVAL OCEAN SYSTEMS CENTER
San Diego, California 92152

NOSC TD 432

NOSC TD 432

Technical Document 432

PRODUCT ASSURANCE REQUIREMENTS GUIDE FOR NAVAL OCEAN SYSTEMS CENTER PROJECTS

Product Assurance Division
Code 931

21 December 1982

NOSC

NAVAL OCEAN SYSTEMS CENTER
San Diego, California 92152

NAVAL OCEAN SYSTEMS CENTER, SAN DIEGO, CA 92152

AN ACTIVITY OF THE NAVAL MATERIAL COMMAND

JM PATTON, CAPT, USN
Commander

HL BLOOD
Technical Director

ADMINISTRATIVE INFORMATION

This document identifies and describes those product assurance program elements which are to be considered when planning Naval Ocean Systems Center (NOSC) development or production projects.

The document was prepared by the Product Assurance Division, Code 931 (E. J. Thirkill, C. A. Lanning) under NOSC funding.

Released by
E. J. Thirkill, Head
Product Assurance Division

Under authority of
D. P. Newman, Head
Product Engineering Department

FOREWORD

This document, referred to in NOSCINST 4855.1, "NOSC Product Assurance Program," identifies and describes those product assurance program elements which are to be considered when planning NOSC development or production projects, whether such effort is to be performed in-house or under contract. Since most of NOSC's work is accomplished under contract, the recommended product assurance requirements provided here have been expressed in language suitable for direct inclusion in a contract Statement of Work. It is important to note that these requirements can and should be selected and tailored, as necessary, to suit the specific needs of the project.

A comprehensive bibliography and summary of the major product assurance policy and guidance documents are included. In the appendices, checklists are provided which identify those specific product assurance program elements typically present in major programs. Recommendations also are offered regarding product assurance data requirements and suggested Data Item Descriptions. Examples of comprehensive configuration management, quality assurance, procurement data, commercial equipment selection and other contractual requirements are provided, as well.

It is intended that this document will be updated and expanded as necessary and that change pages will be issued. Suggestions for improvement are welcome and should be forwarded to the Product Assurance Division, Code 931.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NOSC Technical Document 432 (TD 432)	2. GOVT ACCESSION NO. A126 678	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) PRODUCT ASSURANCE REQUIREMENTS GUIDE FOR NAVAL OCEAN SYSTEMS CENTER PROJECTS		5. TYPE OF REPORT & PERIOD COVERED 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Product Assurance Division, Code 931		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Ocean Systems Center San Diego, CA 92152		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE 21 December 1982 13. NUMBER OF PAGES 271
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION, DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Product Assurance Technology
Product Assurance Program
Product Assurance Requirements

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

NOSC TD 432 identifies and describes those product assurance program elements, including reliability, maintainability, quality assurance, system safety, configuration management and integrated logistics support which are to be considered (see NOSCINST 4855.1) when planning Naval Ocean Systems Center (NOSC) projects. It provides the NOSC program manager with guidelines to select appropriate product assurance requirements for all phases of engineering development, production and in-service operation whether the effort is to be accomplished in-house or under contract. Since much of NOSC's work is accomplished under contract, the recommended product assurance

(Continued on reverse side)

DD FORM 1473 1 JAN 73 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20. Continued

requirements have been expressed in language suitable for direct inclusion in a contract Statement of Work. A comprehensive bibliography and summary of the major product assurance policy and guidance documents are included. Guidance regarding product assurance data requirements is provided as well. Examples of comprehensive configuration management, quality assurance, procurement data, commercial equipment selection and other contractual requirements are provided, as well.

GLOSSARY AND ACRONYMS

ACO	Administrative Contracting Officer
ADP	Automatic Data Processing
AMSDL	Acquisition Management Systems and Data Requirements Control List
AQL	Acceptable Quality Level
ASU	Approval for Service Use
CAR	Configuration Audit Review
CBIL	Common and Bulk Items List
CCs	Classification of Characteristics
CCB	Change Control Board
CCB/SCCB	Configuration Control Board/Software Change Control Board
CCD	Configuration Control Desk
CDR	Critical Design Review
CDRL	Contract Data Requirements List (DD 1423)
CI	Configuration Item
CM	Configuration Management
CSAR	Configuration Status Accounting Report
DAR	Defense Acquisition Regulation
DCAS	Defense Contracts Administration Service
DID	Data Item Description (DD 1664)
DNSARC	Department of the Navy System Acquisition Review Council
DOD	Department of Defense
DRRB	Data Requirements Review Board
DSARC	Defense Systems Acquisition Review Council
ECP	Engineering Change Proposal
EED	Electro Explosive Device
ER	Established Reliability
FAI	First Article Inspection
FCA	Functional Configuration Audit
FHA	Fault Hazard Analysis
FMECA	Failure Mode, Effect and Criticality Analysis
FQR	Formal Qualifications Review
FR	Failure Rate
FTA	Fault Tree Analysis
GFM/GFE	Government Furnished Material or Government Furnished Equipment
GIDEP	Government Industry Data Exchange Program
HE	Human Engineering
HERO	Hazards of Electromagnetic Radiation to Ordnance
IDS	Interface Design Specification
ILS	Integrated Logistics Support
ILSP	Integrated Logistics Support Plan
IMA	Intermediate Maintenance Activity
IPB	Initial Product Baseline
IRI	Interchangeable Replacement Item
ITP	Integrated Test Program
ITPP	Integrated Test Program Plan
LASER	Light Amplification by Stimulated Emission of Radiation
LORA	Level-of-Repair Analysis
LSA	Logistic Support Analysis, Laser Safety Analysis
LSRB	Laser Safety Review Board

LSS	Logistic Support Summary
LTPD	Lot Tolerance Percent Defective
METRL	Metrology Requirements List
MIP	Maintenance Index Pages
MRC	Maintenance Requirements Cards
MTBF	Mean Time Between Failures
MTBMA	Mean Time Between Maintenance Action
MTTR	Mean Time To Repair
NAVOCEANSYSCEN	Naval Ocean Systems Center
NAVPRO	Naval Plant Representative Office
NAVSEASYSCOM	Naval Sea Systems Command
NOR	Notice of Revision
O&S	Operational and Support
ORDALT	Ordnance Alteration
PAPP	Product Assurance Program Plan
PAS	Pre-Award Survey
PB	Product Baseline
PCA	Physical Configuration Audit
PCO	Procurement Contracting Officer
PDR	Preliminary Design Review
PHA	Preliminary Hazard Analysis
PIND	Particle Impact Noise Detection
PMP	Program Management Plan
POS	Product Oriented Survey
PPS	Program Performance Specification
PPSL	Program Parts Selection List
PQA	Procurement Quality Assurance
QA	Quality Assurance
QATIP	Quality Assurance Test and Inspection Plan
QSR	Quality System Review
RADHAZ	Radiation Hazard
rf	Radio Frequency
RFP	Request for Proposal
R&M	Reliability and Maintainability
SCA	Sneak Circuit Analysis
SCN	Specification Change Notice
SSHA	Subsystem Hazard Analysis
SSP	System Safety Program
SSPP	System Safety Program Plan
SYSCOM	Systems Command
TDA	Technical Direction Agent
TECH/OPEVAL	Technical Evaluation/Operational Evaluation
TMCR	Technical Manual Contract Requirement
TX	Testing Extra
UDR	Urgent Data Request
VSM	Visual Search Microfilm
WBS	Work Breakdown Structure
W/Ds	Waivers/Deviations
WSESRB	Weapon System Explosives Safety Review Board

CONTENTS

---

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

---

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

---

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

APPENDICES

TABLES

1. SCOPE

1 SCOPE

1.1 PURPOSE

This document, referred to in NOSCINST 4855.1, "NOSC Product Assurance Program," identifies and describes those product assurance program elements, including reliability, maintainability, quality assurance, system safety, configuration management and integrated logistic support, which are to be considered when planning Naval Ocean Systems Center (NOSC) projects. It provides the NOSC project manager with guidelines for the selection of appropriate product assurance requirements for all phases of engineering development, production and in-service operation whether the effort is to be accomplished in-house or under contract.

1.2 OBJECTIVES

The primary objective of a product assurance program is to ensure, through an integrated and systematic approach, that manufactured products will achieve a level of quality consistent with operational requirements and specifications. When those manufactured products include naval systems and equipment intended for eventual fleet use, as with the typical NOSC project, it is absolutely essential to have effective product assurance planning and implementation.

1.3 APPLICABILITY AND USE

The elements of this guide, with tailoring of requirements as may be appropriate, are applicable on a selected basis to NOSC programs which are in any phase of engineering development, production or in-service operation, whether the project effort is to be performed in-house or under contract. These elements may be applied selectively to a variety of program activities including system or system equipment design and development, manufacturing, test and evaluation and maintenance, overhaul and repair. They also may be applied to a variety of supporting engineering efforts such as components, materials, processes or computer software development efforts. The extent to which the individual sections and elements of this guide apply will depend entirely on the nature and complexity of the program and the intended use of its products. To enable this document to be used easily by the NOSC project office, product assurance program requirements and documentation requirements checklists are provided in Appendices A and B.

Since much of the Center's development work is performed under contract and since most of the product assurance effort on these programs is accomplished by the prime contractor having the system development responsibility, <u>the requirements sections of this guide have been expressed, wherever practical, in language suitable for direct inclusion in a contract Statement of Work</u>. Those requirements sections which are suitable for direct inclusion in a contract Statement of Work are identified by an asterisk (*) located in the left-hand margin. The expression of these requirements in contractual language, however, should not be taken to infer that a requirement is not pertinent or otherwise appropriate when the work is performed in-house or is performed at another government facility. Except in a few cases, the principles embodied in the individual requirements statements apply equally to work

accomplished in-house. It is left to the program manager's discretion to determine which requirements are appropriate to the project, whether the effort is to be conducted in-house or under contract. Except where the requirement is thought to be self-explanatory, the requirements sections are preceded with general statements which are intended to provide an understanding of the need for the requirement and/or guidance concerning its application.

Section 2 includes a comprehensive bibliography of those DOD and Navy instructions, standards, specifications and handbooks which establish product assurance policy and define the related procedural requirements. Whenever such documents are invoked in a contract or other order, it should be stipulated that "the document issue in effect on the date of invitation of bids represents the contract requirement." For this reason, all references to such documents used here in conjunction with recommended contractual requirements statements purposely do not reflect the document issue.

Section 3, the requirements section, is divided into five main sections:

SECTION 3.1 PROGRAM MANAGEMENT

An accumulation of product assurance program management requirements, including the traditional reliability, maintainability, quality assurance, system safety, configuration management and integrated logistics support elements. These requirements should be considered for applicability during development and production.

SECTION 3.2 PROCUREMENT

Requirements applicable to the planning for and the procurement of materials, products or services from a supplier. These requirements should be considered for applicability during development and production.

SECTION 3.3 DEVELOPMENT

Requirements which should be considered for applicability during the conceptual, validation and full-scale development phases, with emphasis on the latter development phases. Certain of these requirements may be applicable to production, as well.

SECTION 3.4 PRODUCTION

Requirements which should be considered for applicability to the production phases. Certain of these requirements will be applicable to the full-scale development phase, as well.

SECTION 3.5 TEST AND INSPECTION EQUIPMENT AND STANDARDS

Requirements which should be considered for applicability to a contractor's operation during both development and production. Certain of these requirements will be applicable to an in-house operation, as well.

1.4 DEFINITIONS

The following definitions are provided to assure a uniform understanding of selected terms as they are used in this document:

a. Acceptance - The act of an authorized representative of the government by which the government assures for itself, or as an agent of another, ownership of existing and identified supplies tendered, or approves specific services rendered, as partial or complete performance of the contract on the part of the contractor (ASPR 14-001.6).

b. Approval - Written concurrence by the government representative, unless otherwise specified by the procuring activity.

c. Baseline - A configuration identification document (engineering drawing, list, specification, etc.) or a set of such documents formally designated and fixed at a specific time. Baselines, plus approved changes from those baselines, constitute the current configuration identification for a product. For configuration management purposes there are three baselines: functional, allocated and product. The product baseline is the final baseline and the one to which production units will be fabricated.

d. Computer Software - A combination of associated computer programs, firmware and data required to enable designated computer equipment to perform computational or control functions.

e. Configuration Item (CI) - An aggregation of hardware/software, or any of their discrete portions, which satisfies an end use function and is designated by the government for configuration management (DOD-STD-480).

f. Contractor - Any organization which furnishes products or services to a government procuring activity, under a contractual arrangement.

g. Deviation - A specific written authorization, granted prior to the manufacture of an item, to depart from a particular performance or design requirement of a specification, drawing or other document for a specified number of units or a specific period of time; deviations are considered to be one of three categories: critical, major or minor.

h. Engineering Change - An alteration in the configuration of a configuration item or items delivered, to be delivered, or under development, after formal establishment of its configuration identification (DOD-STD-480).

i. Engineering Change Proposal (ECP) - A term which includes both a proposed engineering change and the documentation in which the change is described and suggested; ECPs are either Class I (generally those affecting performance, reliability, maintainability, safety, interchangeability, life, contract cost or schedule - see DOD-STD-480) or Class II (all others). ECPs are one of two types, either preliminary or formal and routine, urgent or emergency in priority. An ECP generally includes one or more notices of revision (describes changes to engineering drawings/lists) and/or specification change notices (describes changes to specifications).

j. Establish and Maintain - Planning, developing, approving, implementing, documenting, updating and performing.

k. Failure - The inability of an item to function within specified limits when called upon to function.

l. Government Representative - The cognizant contract administration office unless otherwise specified by the procuring activity.

m. Ordnance Equipment - Any military equipment, including weapon systems, command control and communications equipment, intelligence equipment, surveillance equipment, military undersea vehicles and those items of equipment used in the servicing or maintenance of military equipment.

n. Procurement Data - Those technical data items which will be used to fabricate a product in production and verify the quality of the production units; procurement data include engineering drawings, drawing and parts lists, special or unique manufacturing procedures or processes, special quality assurance requirements and material, process and product specifications.

o. Product(s) - Includes materials, supplies, components, subassemblies, assemblies, equipment, systems, computer software or other purchased or fabricated items.

p. Product Assurance Program - Those integrated disciplines and activities (i.e., reliability, maintainability, quality assurance, system safety, configuration management, integrated logistics support) which are required to assure the overall quality, reliability and availability of the system/equipment throughout its life cycle.

q. Subcontractor - Any supplier, distributor, vendor or firm which furnishes products or services to a contractor.

r. <u>Supportability</u> - The ability to satisfy material and administrative requirements associated with restoring the operation of a failed system or equipment, or the probability that delays incident to restoration of an item to a specified condition will be within a given period of time, when existing administrative and logistics channels are utilized.

s. <u>Technical Data</u> - Any recorded information, regardless of form or characteristic, of a scientific or technical nature; the data may be graphic or pictorial delineations in media such as: drawings or photographs, text in specifications, related performance or design type documents in machine form such as punched cards, magnetic tape, computer memory printouts, or may be retained in computer memory; technical data include: research and engineering data, engineering drawings and associated lists, specifications, standards, process sheets, manuals, product assurance plans and reports, project status reports and various items of computer software.

t. <u>Waiver</u> - A specific written authorization to accept a configuration item or other designated item which, during production or when submitted for inspection, is found to deviate from specified requirements, but nevertheless is considered suitable for use "as is" or after rework by an approved method. Waivers are considered to be one of three categories: critical, major or minor.

2. APPLICABLE DOCUMENTS

2. APPLICABLE DOCUMENTS

The following provides a comprehensive bibliography and brief summary of those major DOD and Navy directives, instructions, standards, specifications and handbooks dealing with the product assurance elements of reliability, maintainability, quality assurance, system safety, configuration management and integrated logistics support. The current issue date of these documents available at the time of writing is included for information purposes. Whenever these documents are cited in a contract or other order the "issues in effect on the date of invitation of bids" should always be stipulated as the contract requirement.

2.1 RELIABILITY, MAINTAINABILITY AND AVAILABILITY ASSURANCE DOCUMENTS

2.1.1 DIRECTIVES AND INSTRUCTIONS

SECNAVINST 3900.36A, "Reliability and Maintainability (R&M) of Naval Material; policy for," 17 Jun 1970

Establishes policy for the guidance of efforts to increase the reliability and maintainability of Navy and Marine Corps systems and equipments and assigns responsibility for their achievement.

NAVMATINST 3000.1A, "Reliability of Naval Material," 22 Apr 1977

Establishes CNM policy for the acquisition and deployment of reliable material and provides direction for their implementation.

NAVMATINST 3000.2, "Operational Availability of Weapons Systems and Equipments; definitions and policy," 21 Jan 1981

Establishes the operational availability (A_o) as the primary measure of material readiness for Navy weapons systems and equipment and provides policy and methods of calculation.

NAVMATINST 3900.13, "Preproduction Reliability Design Review," 13 Nov 1975

Establishes policy and direction for the implementation of a Preproduction Reliability Design Review (PRDR) to be incorporated in the weapon systems acquisition cycle.

NAVSEAINST 3900.2A, "Reliability and Maintainability Program of the Naval Sea Systems Command for Design, Development, and Acquisition (Non-Nuclear)," 18 Apr 1979

Promulgates NAVSEA policy for the design, development and acquisition of reliable and maintainable Naval material.

NOSCINST 4855.1, "NOSC Product Assurance Program," 19 Aug 1981

Establishes policy and states requirements for the Naval Ocean System Center's Product Assurance Program including requirements regarding

quality assurance, reliability, maintainability, system safety, human factors, configuration management and integrated logistics support. Establishes requirements for project design reviews.

NAVELEXINST 4858.2, "Naval Electronic Systems Command Reliability Program," 31 May 1977

Prescribes basic policy for developing and implementing Naval Electronic Systems Command Reliability Program requirements and provides guidance and specific direction to achieve the specified level of reliability of NAVELEX equipment and systems commensurate with operational and user requirements.

NAVELEXINST 4858.3, "Naval Electronic Systems Command Maintainability Program," 31 May 1977

Delineates the basic policies, specific directions and designation of responsibilities in developing and implementing the NAVELEX maintainability program requirements.

DOD Directive 5000.40, "Reliability and Maintainability," 8 Jul 1980

Establishes DOD policy for reliability and maintainability.

NAVAIRINST 13070.2B, "Policy for Reliability and Maintainability (R&M) of Naval Aeronautical Systems and Equipment," 24 Jan 1977

Promulgates policy governing reliability and maintainability (R&M) programs and delineates responsibilities for these programs.

2.1.2 STANDARDS

MIL-STD-470, "Maintainability Program Requirements," 21 Mar 1966

Provides requirements for establishing a maintainability program and guidelines for the preparation of a maintainability program plan.

MIL-STD-471A, "Maintainability Verification/Demonstration/Evaluation," Notice 2, 8 Dec 1978

Provides procedures and test methods for verification, demonstration and evaluation of qualitative and quantitative maintainability requirements.

MIL-STD-690B, "Failure Rate Sampling Plans and Procedures," Notice 2, 1 Aug 1974

Procedures for failure rate qualification, sampling plans (based on exponential distribution) for establishing and maintaining failure rate levels and lot conformance inspections procedures associated with failure rate testing.

MIL-STD-721C, "Definitions of Effectiveness Terms for Reliability, Maintainability, Human Factors, and Safety," 12 Jun 1981

Defines terms most often used in reliability, maintainability, human factors and safety.

MIL-STD-756B, "Reliability Modeling and Prediction," 18 Nov 1981

Establishes uniform procedures for predicting the quantitative reliability of aircraft, missiles, satellites, electronic equipment throughout the development phases to reveal design weaknesses and to form a basis for apportionment of reliability requirements to the various subdivisions of the product.

MIL-STD-781C, "Reliability Design Qualification and Production Acceptance Tests: Exponential Distribution," 21 Oct 1977

Delineates the requirements for reliability qualification tests (preproduction) and reliability acceptance tests (production) for equipments that experience an exponential failure distribution.

MIL-STD-785B, "Reliability Program for Systems and Equipment Development and Production," 15 Sep 1980

Establishes uniform criteria for a reliability program and provides guidelines for the preparation and implementation of a reliability program plan.

MIL-STD-790C, "Reliability Assurance Program for Electronic Parts Specification," Notice 1, 2 Nov 1979

Provides reference to electronic parts reliability (ER) specifications and establishes the criteria for a reliability assurance program for manufacturers qualifying electronic parts to the specification.

MIL-STD-1629A, "Procedures for Performing a Failure Mode, Effects and Criticality Analysis," 24 Nov 1980

Establishes a uniform step-by-step procedure for performing a Failure Mode, Effects and Criticality Analysis (FMECA).

MIL-STD-1635, "Reliability Growth Testing," 3 Feb 1978

Establishes procedures and requirements for reliability development growth tests.

MIL-STD-2068, "Reliability Development Tests," 21 Mar 1977

Establishes requirements and procedures for a reliability development test to implement the MIL-STD-785 requirement for such a test. The purpose is to promote reliability improvement in an orderly and standardized manner.

MIL-STD-2074, "Failure Classification for Reliability Testing," 15 Feb 1978

Provides criteria for the classification of failures associated with reliability testing.

2.1.3 SPECIFICATIONS

MIL-R-22732C (Ships), "Reliability Requirements for Shipboard Electronic Equipment," 12 Nov 1973

Establishes the procedures and requirements for achieving and verifying adequate levels of reliability during the development and production of shipboard electronic equipment.

2.1.4 HANDBOOKS

TR-4, "Sampling Procedures and Tables for HFE and Reliability Testing Based on the Weibull Distribution," 28 Feb 1962

Establishes procedures for application of the Weibull distribution to life/reliability testing.

TR-7, "Factors and Procedures for Applying MIL-STD-105D Sampling Plans to Life and Reliability Testing," 21 May 1965

Establishes procedures for life/reliability testing utilizing MIL-STD-105D.

Quality Control and Reliability Handbook (Interim) H108, "Sampling Procedures and Tables for Life and Reliability Testing (Based on Exponential Distribution)," 29 Apr 1960

Presents procedures and tables for life and reliability testing.

MIL-HDBK 189, "Reliability Growth Management," 13 Feb 1981

Provides an understanding of the concepts and principles of reliability growth, advantages of managing reliability growth and guidelines and procedures to be used.

MIL-HDBK 217D, "Reliability Prediction of Electronic Equipment," 15 Jan 1982

Presents data and procedures for performing reliability predictions on equipment.

NPRD-1, "Non-Electronic Parts Reliability Data," Summer 1978

Prepared by the Reliability Analysis Center of the Rome Air Development Center, Griffiss Air Force Base. Provides reliability data concerning non-electronic parts. Intended to complement MIL-HDBK-217.

Reliability Design Handbook, No. RDH 376, Mar 1976

Prepared by the Reliability Analysis Center of the Rome Air Force Development Center, Griffiss Air Force Base. A guide for designers of military equipment to achieve reliable products by providing information, factors and parameters affecting reliability.

MIL-HDBK 472, "Maintainability Prediction," 24 May 1966

Methods, procedures and data for performing maintainability predictions.

NAVMAT P-9492, "Navy Manufacturing Screening Program," May 1979

Provides guidance concerning the use of temperature cycling and random vibration as manufacturing screens for defects in both parts and workmanship.

NAVSEA TE001-AA-GYD-010/SCA, "Contracting and Management Guide for Sneak Circuit Analysis (SCA)," (No Date)

Establishes guidelines for implementing and managing a sneak circuit analysis program.

NAVELEX 0967-437-7040, "Reliability/Design Handbook – Thermal Applications," July 1973

Provides guidelines for engineers regarding the thermal design of Naval electronic equipment with improved reliability.

NAVSEA 0967-LP-597-1011, "Parts Application and Reliability Information Manual for Navy Electronic Equipment," Oct 1980

Procedures and techniques to assure reliability by standardization, screening and proper application.

NAVSEA S-0300-AS-PLL-010/DSGN, "NAVSEA Standard Parts List," Oct 1980

Provides a technical baseline for the standardization of electronic parts for use in the design and development of systems and equipment.

2.2 QUALITY ASSURANCE DOCUMENTS

2.2.1 DIRECTIVES AND INSTRUCTIONS

DOD Directive 4155.1, "Quality Program," 10 Aug 1978

Establishes DOD quality program policies for products and services and assigns responsibilities.

SECNAVINST 4855.1, "Quality Assurance Program," 10 Sep 1979

Implements the Department of Defense (DOD) policies and assigns basic responsibilities. Establishes quality program policies for products and services and assigns responsibilities.

NAVMATINST 4855.1A, "Quality Assurance Policy for the Naval Material Command," Change 1, 1 Jun 1976

Establishes policies, principles and responsibilities for implementation and monitoring weapon/support systems.

NAVMATNOTE 4855, "Naval Material Command Quality Assurance Program," 23 Sep 1976

Establishes policy for the new look in quality assurance for the Naval Material Command.

NAVSEAINST 4855.5A, "Quality Assurance Program of the Naval Sea Systems Command," 2 Feb 1982

Promulgates NAVSEA policy, procedures and specifications for defining and implementing the NAVSEA quality assurance program.

NAVSEAINST 4855.16, "Quality Assurance Test and Inspection Plans for Ordnance Materials," 27 Jan 1977

Establishes policy and procedures for preparation, maintenance and use of standardized inspection documents in the form of quality assurance test and inspection plans (QATIPS) for use in the test and inspection of ordnance material, weapons and weapon systems at NAVSEASYSCOM shore and fleet activities.

NAVSEAINST 4855.29, "Reliability and Quality Requirements for Procurement and Reprocurement of Spares and Repair Parts for NAVSEA Systems and Equipments," 27 Oct 1981

Establishes policy requiring procurement documentation (i.e., drawings) for anticipated spare and repair parts be obtained during full-scale development and contain adequate quality and reliability requirements.

NAVAIRINST 5400.23C, "Quality Assurance Program of the Naval Air Systems Command," 12 Mar 1981

This instruction implements a quality assurance program, defines and assigns responsibility for the Naval Air Systems Command.

NAVELEXINST 4855.2A, "Naval Electronic Systems Command Quality Assurance Program," 27 Jan 1977

Establishes policy and responsibility for the management of the quality assurance program.

NAVSEASYSCOM QAP 000, "Naval Ordnance Activity Quality Assurance Procedures," revision 3-1, Jan 1977

Establishes NAVSEASYSCOM policy for the establishment and maintenance of a quality assurance program at naval ordnance activities (naval ammunition depots, naval ordnance stations, naval weapons stations, naval weapons support centers, naval undersea warfare engineering stations).

NAVSEASYSCOM QAP 100, "Quality Assurance Procedures for Fleet Activities," revision 1, 1 Dec 1976

Establishes quality assurance program requirements and procedures to be applied by fleet activities during receipt, segregation, renovation, maintenance, storage and issue of ordnance materials.

NAVSEASYSCOM QAP 200, "Naval Sea Systems Command Engineering Agent Reliability, Maintainability and Quality Assurance Program Requirements," 30 May 1979

The document provides a ready means for a technical manager to selectively tailor R/M&QA requirements for a particular system or equipment.

2.2.2 STANDARDS

MIL-STD-105D, "Sampling Procedures and Tables for Inspection by Attributes," Notice 2, 1 Nov 1978

Establishes sampling plans and procedures for inspection by attributes.

MIL-STD-109B, "Quality Assurance Terms and Definitions," 4 Apr 1969

Defines quality assurance terms.

MIL-STD-120, "Gage Inspection," 12 Dec 1950

Defines gage inspection methods.

MIL-STD-202F, "Test Methods for Electronic and Electrical Component Parts," Change Notice 2, 27 Jan 1982

Provides test procedures for testing electronic and electrical parts.

MIL-STD-252B, "Wired Equipment, Classification of Visual and Mechanical Defects," 19 Jan 1970

Provides criteria for classification of defects of wired equipment.

MIL-STD-271E, "Nondestructive Testing Requirements for Metals," 31 Oct 1973

Establishes requirements for nondestructive testing.

MIL-STD-410D, "Nondestructive Testing Personnel Qualification and Certification (Eddy Current, Liquid Penetrant, Magnetic Particle, Radiographic and Ultrasonic)," 23 Jul 1974

Establishes the certification requirements for personnel performing nondestructive testing.

MIL-STD-414, "Sampling Procedures and Tables for Inspection by Variables for Percent Defective," Change Notice 1, 8 May 1968

Establishes sampling procedures for inspection by variables.

MIL-STD-454G, "Standard General Requirements for Electronic Equipment," Notice 3, 10 Sep 1981

Requirement 5 covers soldering procedures. Requirement 9 covers workmanship criteria.

MIL-STD-883B, "Test Methods and Procedures for Microelectronics," 15 Jan 1982

Provides microelectronic test methods and procedures.

MIL-STD-1235B, "Single and Multilevel Continuous Sampling Procedures and Tables for Inspection by Attributes," 10 Dec 1981

Provides plans for inspection by attributes on a continuous sampling basis.

MIL-STD-1556A, "Government/Industry Data Exchange Program Contractor Participation Requirements," 29 Feb 1976

Establishes a component/equipment data exchange program between government and industry for the communication of quality, reliability and other data.

MIL-STD-45662, "Calibration Systems Requirements," 10 Jun 1980

Establishes the requirements for a contractor's calibration system.

2.2.3 SPECIFICATIONS

MIL-Q-9858A, "Quality Program Requirements," Amendment 1, 7 Aug 1981

Establishes the requirements for a contractor's hardware quality assurance program, including control of work operations and manufacturing processes. See Paragraph 3.1.17 for a comparison of MIL-Q-9858A and MIL-I-45208A requirements.

MIL-I-45208A, "Inspection System Requirements," Amendment 1, 24 Jul 1981

Establishes the requirements for a contractor's inspection system.

MIL-Q-45970A, "Quality Assurance for Weapons and Support Material," 1 Oct 1975

Establishes quality assurance requirements for parts, assemblies, subsystems and systems.

MIL-S-52779A, "Software Quality Assurance Program Requirements," 1 Aug 1979

Establishes the requirements for a contractor's computer software quality assurance program.

MIL-M-85337(AS), "Manuals, Technical: Quality Assurance Program; requirements for," 23 Sep 1980

Establishes quality assurance program requirements for technical manuals.

2.2.4 HANDBOOKS

MIL-HDBK-H50, "Evaluation of a Contractor's Quality Program," 23 Apr 1965

Provides criteria for evaluating a contractor's quality assurance program.

MIL-HDBK-H51, "Evaluation of a Contractor's Inspection System," 3 Jan 1967

Provides criteria for evaluating a contractor's inspection system.

MIL-HDBK-H52, "Evaluation of a Contractor's Calibration System," 7 Jul 1964

Provides criteria for evaluating a contractor's calibration system.

MIL-HDBK-H53, "Guide for Sampling Inspection," 30 Jun 1965

Provides guidance in establishing sample inspection.

MIL-HDBK-H107, "Single Level Continuous Sampling Procedures and Table for Inspection by Attributes," 30 Apr 1959

Establishes an inspection by attributes procedure.

MIL-HDBK-H109, "Statistical Procedures for Determining Validity of Suppliers' Attributes Inspection," 6 May 1960

Provides appropriate statistical tests and tables for use in determining the validity of suppliers' inspection records when sampling inspection by attributes is specified.

NELC TD 251, "Navy Systems Effectiveness Manual," 5 Oct 1973

Provides a discussion of those factors (reliability, safety, vulnerability/survivability, electromagnetic compatibility, etc.) which contribute to system effectiveness.

NAVSEA OD 46574A, "Product Quality Program Requirements for Acquisition of Naval Sea Systems Command Material," May 1975

Provides a comprehensive guide for planning and contractually implementing an overall product quality program.

NAVSEA OD 45845, NAVAIR 17-35MTL-1, NAVELEX 0969-LP-133-2010, "Metrology Requirements List (METRL)," 1 Apr 1981

An authoritative reference document containing data applicable to calibration of Navy test, measuring and diagnostic equipment (TMDE) and standards. Provides information concerning calibration intervals and procedures.

2.3 SYSTEM SAFETY ASSURANCE DOCUMENTS

2.3.1 DIRECTIVES AND INSTRUCTIONS

SECNAVINST 5100.10D, "Department of the Navy Occupational Safety and Health Policy; implementation of," 11 Oct 1978

Establishes the Department of Navy occupational safety and health policies and assigns responsibility for accident prevention, safety and occupational health programs.

OPNAVINST 5100.8E, "Navy Safety and Occupational Health Program; implementation of," May 1978

Describes and implements the Navy's safety and occupational health program and assigns responsibility for administering each element of the program.

NAVMATINST 5100.6A, "System Safety Program; implementation of," 28 Feb 1980

Provides policy and guidance for the incorporation of safety programs in the process of acquiring systems and equipment provided by the Naval Material Command.

NAVMATINST 5100.10, "Safety Responsibilities in Designated Project Management Offices Within the Naval Material Command," 20 Aug 1976

Reestablishes requirements that designated project managers within the Naval Material Command clearly define safety responsibilities.

NAVSEAINST 5100.5, "Hazardous Material Safety Program," 16 Dec 1976

Establishes the Naval Sea Systems Command Hazardous Material Safety Program responsibilities.

NAVSEAINST 5100.6A, "Safety Program; command policy and responsibilities concerning," 28 Feb 1980

Establishes the policy and responsibilities for the conduct of the Department of the Navy Safety Program within the Naval Sea Systems Command.

NAVSEAINST 5100.12, "System Safety Program for Ships, Shipborne Systems and Subsystems and Equipment; requirements for implementation of," 16 May 1978

Establishes and promulgates Naval Sea Systems Command uniform policy and guidance for the implementation of MIL-STD-882A for ship system safety programs under NAVSEA cognizance.

NAVELEXINST 5100.5A, "Systems Safety Program; implementation of," 8 Dec 1976

Establishes policies and describes criteria to be utilized by the NAVELEXSYSCOM when incorporating provisions for a system safety program into systems procurement.

NAVELEXINST 5100.12, "Navy Laser Hazards Prevention Program, 8 Feb 1980

Promulgates policies and guidelines for the identification and resolution of laser radiation hazards.

NAVAIRINST 5100.3A, "System Safety Policies; objectives and responsibilities," 15 Oct 1976

Establishes policies, objectives and responsibilities for incorporating system safety into process of systems and equipment acquisition and management within the Naval Air Systems Command (NAVAIR).

NOSCINST 5100.3A, "System Safety Program; implementation of," 5 Aug 1981

States NOSC policy and procedures for implementation of system safety in the development and acquisition of systems and equipment.

NAVSEAINST 8020.6B, "Naval Explosives Safety Program; responsibilities, policies and procedures for," 15 Jun 1978

Implements the Naval Explosives Safety Program; and promulgates policies, requirements and procedures concerning the Weapon System Explosives Safety Review Board (WSESRB).

2.3.2 STANDARDS

MIL-STD-454G (Requirements 1 and 2), "Standard General Requirements for Electronic Equipment," Notice 3, 10 Sep 1981

Requirement 1	Establishes criteria for the design and development of military electronic equipment to promote maximum safety for personnel and equipment.
Requirement 2	Establishes tests for the determination of flammability of materials and the limitation on their use.

MIL-STD-882A, "System Safety Program Requirements," 28 Jun 1977

Provides uniform requirements for developing and implementing a system safety program of sufficient comprehensiveness to identify the hazards of a system and to ensure that adequate measures are taken to eliminate or control the hazards.

MIL-STD-1385, "Preclusion of Ordnance Hazards in Electromagnetic Fields, General Requirements for," 6 Apr 1972

Establishes the general requirements to preclude hazards resulting from ordnance having electroexplosive devices when exposed to electromagnetic fields.

2.3.3 SPECIFICATIONS

NONE

2.3.4 HANDBOOKS

NAVSEA OD 30393, "Design Principles and Practices for Controlling Hazards of Electromagnetic Radiation to Ordnance (HERO Design Guide)," First Revision, 15 Sep 1974

Provides a guide for HERO preventive techniques to be applied to the design and construction of weapon systems and subsystems.

NAVORD OD 44942, "Weapon System Safety Guidelines Handbook," 1 May 1973

PART I	System Manager's Guide to System Safety
PART II	System Safety Management Guidelines
PART III	System Safety Engineering Guidelines
PART IV	Hazard Control for Explosive Ordnance Production

2.4 CONFIGURATION MANAGEMENT DOCUMENTS

2.4.1 DIRECTIVES AND INSTRUCTIONS

NAVMATINST 4130.1A, "Configuration Management," 1 Jul 1974

Promulgates DOD policies and guidance for DOD components responsible for implementation of configuration management. Defines identifying, controlling, accounting and auditing functions.

NAVSEAINST 4130.10, "Configuration Control Board Operations for Systems and Equipments," 20 Sep 1978

Establishes Configuration Control Board (CCB) operation and uniform procedures for the review and processing of Class I Engineering Change Proposals (ECPs) generated on system and equipment level configuration items.

2.4.2 STANDARDS

DOD-STD-480A, "Configuration Control - Engineering Changes, Deviations and Waivers," Change Notice 1, 29 Dec 1978

Delineates configuration control requirements and provides instructions for preparing and submitting engineering changes and related information. Intended to be imposed on prime contractors who are participating in development or have experience in production of systems of high level configuration items (CIs).

MIL-STD-481A, "Configuration Control Engineering Changes, Deviations and Waivers (Short Form)," 18 Oct 1972

Establishes requirements for preparation and submittal of abbreviated engineering change proposals, wherein the procuring activity assumes the major responsibility for determining higher level effects.

MIL-STD-482A, "Configuration Status Accounting Data Elements and Related Features," 1 Apr 1974

Prescribes status-accounting standard data elements and related features, but does not prescribe or restrict use of features for any

given program. Intended to be used as a guide for procuring, managing and reporting activities, to enable them to select and specify requirements.

MIL-STD-483, "Configuration Management Practices for Systems, Equipment, Munitions and Computer Programs," Notice 2, 21 Mar 1979

Establishes requirements for configuration management in the following areas:

a. Management plan
b. Identification
c. Audits
d. Interface control
e. Control
f. Engineering release control
g. Management

MIL-STD-1456, "Contractor Configuration Management Plans," Notice 2, 30 Oct 1981

Establishes uniform practices for preparation of configuration management plans by contractors, in response to requirements in RFPs, etc.

MIL-STD-1521A, "Technical Reviews and Audits for Systems, Equipments and Computer Programs," Notice 2, 21 Dec 1981

Prescribes requirements for conduct of technical reviews and audits on systems, equipments and computer programs. Appendices E and F describe functional and physical configuration audits.

2.4.3 SPECIFICATIONS

NONE

2.4.4 HANDBOOKS

NONE

2.5 INTEGRATED LOGISTIC SUPPORT DOCUMENTS

2.5.1 DIRECTIVES AND INSTRUCTIONS

DOD DIRECTIVE 5000.39, "Acquisition and Management of Integrated Logistic Support for Systems and Equipment," 17 Jan 1980

Establishes DOD policy and assigns responsibility for Integrated Logistic Support (ILS) including the acquisition of ILS as an integral part of the systems and equipment acquisition process.

SECNAVINST 5000.39A, "Acquisition and Management of Integrated Logistic Support (ILS) for Systems and Equipment," 2 Mar 1981

Implements DOD Directive 5000.39 and establishes Navy policy and assigns responsibility for Integrated Logistic Support (ILS) including the acquisition of ILS as an integral part of the systems and equipment acquisition process.

OPNAVINST 4100.3A, "Department of the Navy Integrated Logistic Support (ILS) System," 6 Nov 1972

Directs the development and implementation of the ILS system concept within the Navy, not including the Marine Corps, and establishes basic CNO policies regarding the subject.

OPNAVINST 4441.12A, "Supply Support of the Operating Forces," Change 1, 13 Mar 1975

States basic Navy policy governing the determination of Fleet materiel requirements in support of installed equipments and systems, the distribution of Fleet materiel assets and the prescribed shipboard stock levels.

NAVMATINST P-4000, "ILS Implementation Guide for DOD Systems and Equipments," 1 Mar 1972

Assists program managers in government and industry in the implementation of the policy contained in DOD Directive 4100.35.

NAVMATINST 4000.20B, "ILS Planning Policy," Change 1, 26 Jan 1976

Establishes NAVMAT policies and principles for the life cycle support of systems/equipments.

NAVMATINST 4150.1, "Uniform Technical Documentation for Use in Provisioning of End Items of Material," 28 Jan 1981

Implements DODINST 4151.7 (same title) of 30 Jun 1980 within the Naval Material Command. DODINST 4151.7 establishes uniform provisioning technical documentation requirements for DOD.

NAVSEAINST 4105.1, "ILS; Policy, Responsibilities and Planning," Change 2, 1 Feb 1980

Addresses NAVSEA ILS requirements for each system life cycle phase.

NAVAIRINST 4000.2C, "ILS Planning Procedures," 15 Jun 1976

Establishes the requirement for implementation within the NAVAIRSYSCOM of the ILS procedures and concepts promulgated by NAVMATINST 4000.20.

NAVELEXINST 4000.6C, "ILS; policy and responsibilities," 30 Oct 1979

Implements and amplifies NAVELEX policy and guidance for the application of ILS planning.

2.5.2 STANDARDS

MIL-STD-1369, "ILS Program Requirements," Change Notice 2, 29 Apr 1977

Provides formal guidance for the development and implementation of an Integrated Logistic Support Plan (ILSP).

MIL-STD-1375, "Provisioning, Initial Support, general requirements for," Change Notice 1, 29 Nov 1974

Prescribes procedures, formats, terms and conditions governing the provisioning of end items of equipment.

MIL-STD-1388-1, "Logistic Support Analysis," Change Notice 3, 15 Apr 1978

Defines support system requirements and injects support criteria into system/equipment design and acquisition, in a single uniform tri-service process as part of the Integrated Logistic Support Program.

MIL-STD-1390B, "Level of Repair," Notice 1, 19 Feb 1982

Provides methodology to justify a repair or discard decision for failed item of hardware for each anticipated maintenance action.

MIL-STD-1552A, "Provisioning Technical Documentation, uniform DOD requirements for," 17 Mar 1981

Prescribes format and preparation instructions for uniform DOD provisioning (spare parts) technical documentation to be furnished by contractors.

MIL-STD-1561A, "Provisioning Procedures, uniform DOD," 17 Mar 1981

Prescribes terms and conditions governing the provisioning of end items procured by DOD.

2.5.3 SPECIFICATIONS

MIL-P-21873, "Provisioning, Initial Support, general requirement for," 23 Nov 1970

Prescribes procedures, formats, terms and conditions governing the provisioning of end items of equipments. Provides instructions for preparation of Provisioning Technical Documentation (PTD).

MIL-P-21873/1A, "Provisioning Technical Documentation, Interim Repair Parts," 25 Aug 1969

Supplements MIL-P-21873 and establishes detail requirements for Interim Repair Parts (IRP) Provisioning Technical Documentation (PTD).

MIL-P-24534, "Planned Maintenance Subsystem; Development of Maintenance Requirements Cards, Maintenance Index Pages and Associated Documentation," 26 Apr 1976

Establishes requirements for title subjects.

2.5.4 HANDBOOKS

NONE

2.6 TECHNICAL DATA MANAGEMENT, ENGINEERING DRAWINGS AND SPECIFICATIONS, TECHNICAL MANUALS AND RELATED SUBJECT DOCUMENTS

2.6.1 DIRECTIVES AND INSTRUCTIONS

NOSCINST 4000.1A, "Procurement Review Requirements and Data Requirements Review Board (DRRB); establishment of," 24 Mar 1981

Establishes requirements and responsibilities for review and approval of procurements for technical data, product assurance and other technical content.

NAVSEAINST 4000.6, "NAVSEA Data Management Program," 27 Aug 1976

Establishes policy and procedures and assigns responsibilities for the life-cycle management of data and for the inclusion of data requirements in NAVSEA contracts.

NAVAIRINST 4000.9A, "Management of Technical Data," 30 Jul 1971

Establishes policy and delineates responsibilities for the management of NAVAIR technical data.

NAVMATINST 4000.15A, "Department of the Navy Data Management Program," 2 Feb 1971

Establishes the policies and procedures to govern the acquisition of data within the Department of the Navy.

NOSCINST 4160.1, "Technical Manual Procedures," 8 Sep 1981

Establishes policies and procedures for the management, quality assurance, maintenance and acquisition of technical manuals under NOSC cognizance.

NAVMATINST 4160.2, "Technical Manual Management," 24 Nov 1980

Establishes policies and procedures for the management of technical manuals within the Department of the Navy (less Marine Corps).

NAVSEAINST 4855.16, "Quality Assurance Test and Inspection Plans for Ordnance Materials," 27 Jan 1977

Establishes policy and procedures for preparation, maintenance and use of standardized inspection documents in the form of quality assurance test and inspection plans (QATIPs) for use in the test and inspection of ordnance material, weapons and weapon systems at NAVSEASYSCOM shore and fleet activities.

DOD 5000.19-L, "Acquisition Management Systems and Data Requirements Control List - AMSDL," 31 Jan 1980

Provides a numerical and keywork index listing of DOD approved data item descriptions (DD-1664).

DODINST 5000.19-L Vol II, "Acquisition Management Systems and Data Requirements Control List," 31 Jul 1981

Lists all DOD approved data item descriptions (DIDs).

DODINST 5010.12, "Management of Technical Data," Change 1, 7 Apr 1970

Establishes requirements for DOD Technical Data Management Program and defines uniform policies and procedures.

NAVSEAINST 5600.7, "NAVSEASYSCOM Technical Manual Acquisition; policies and responsibility for," 21 Jul 1976

Establishes policy and defines responsibilities and accountability for acquisition and control of commercial manuals, NAVSEA technical manuals and general information manuals.

NAVSEAINST 5600.8, "NAVSEASYSCOM Technical Manual Maintenance; policies, procedures and responsibilities for," 21 July 1976

Establishes policy, requirements and standard procedures for maintenance of NAVSEA technical manuals and general information manuals.

2.6.2 STANDARDS

MIL-STD-12C, "Military Standard Abbreviations for Use on Drawings, Specifications, Standards and in Technical Documents," Supplement 1, Notice 2, 15 Jun 1968

Establishes military standard abbreviations.

DOD-STD-100C, "Engineering Drawing Practices," Notice 1, 30 Apr 1980

Provides practices for preparation of engineering drawings for DOD.

MIL-STD-490, "Specification Practices," Notice 2, 18 May 1972

Establishes uniform specification practices. Covers prime, critical and non-complex item development and fabrication and process and material specifications.

MIL-STD-961A, "Outline of Forms and Instructions for the Preparation of Specifications and Associated Documents," 30 Apr 1981

Establishes the format and instructions for the preparation of specifications and their associated documents.

DOD-STD-1476, "Metric System, Application in New Design," 1 Aug 1977

Defines requirements for utilizing the metric dimensioning system when designing new equipment items.

DOD-STD-2101, "Classification of Characteristics," 10 May 1979

Establishes requirements and procedures for selecting, identifying and classifying essential design characteristics for government acceptance of products.

DSM 4120.3-M, "Defense Standardization Manual," Jan 1972

As related to data, prescribes DOD standardization requirements for preparation of standards and specifications.

2.6.3 SPECIFICATIONS

MIL-S-83490, "Specifications, Types and Forms," 30 Oct 1968

Prescribes general requirements for the preparation of specifications for DOD.

DOD-D-1000B, "Drawings, Engineering and Associated Lists," Amendment 2, 31 Oct 1980

Prescribes requirements for engine[illegible]ng drawings for DOD. Defines Levels I, II and III drawing requirements.

MIL-M-81273A, "Manual, Technical, general specification for," 25 Apr 1966

Establishes general requirements for technical manuals. MIL-M-81273/4A covers requirements for weapons systems manuals.

2.7 HUMAN FACTORS

2.7.1 DIRECTIVES AND INSTRUCTIONS

NAVMATINST 3900.9, "Human Factors," 29 Sep 1970

Establishes policies and requirements necessary to ensure adequate development of human factors aspects of systems and equipment under the cognizance of the Naval Material Command.

2.7.2 STANDARDS

MIL-STD-1472C, "Human Engineering Design Criteria for Military Systems, Equipment and Facilities," Notice 2, 2 May 1981

Presents human engineering design criteria, principles and practices to achieve mission success through integration of the human into the system.

2.7.3 SPECIFICATIONS

MIL-H-46855B, "Human Engineering Requirements for Military Systems, Equipment and Facilities," Amendment 1, 5 Apr 1982

Establishes and defines the general requirements for applying the principles and criteria of human engineering to the concept formulation, definition and acquisition of military systems, equipments and facilities.

2.8 MISCELLANEOUS DOCUMENTS

2.8.1 DIRECTIVES AND INSTRUCTIONS

NOSCINST 3912.1, "Design Review Committee; establishment of," 29 Nov 1979

Establishes the NOSC Design Review Committee and states Center policy relative to design approval and release.

NAVMATINST 4720.1A, "Approval for Service Use of Systems, Equipments, Conventional Weapons and Expendable Ordnance," 8 July 1980

Establishes requirements for obtaining "approval for service use" for NAVMAT material.

NOSCINST 4855.1, "NOSC Product Assurance Program," 19 Aug 1981

Establishes policy and states requirements for NOSC's product assurance program including requirements regarding quality assurance, reliability, maintainability, system safety, human factors, configuration management and integrated logistics support. Establishes requirements for project design reviews.

NAVMATINST 5200.35A, "Government-Industry Data Exchange Program; participation in," 10 Jun 1975

Directs participation in the GIDEP and establishes NAVMAT policy for GIDEP.

NOSCINST 5200.1, "Government-Industry Data Exchange Program (GIDEP); participation in," 17 April 1978

Implements Center participation in GIDEP and establishes Center policy and procedures.

2.8.2 STANDARDS

MIL-STD-143B, "Standards and Specifications; order of precedence for the selection of," 12 Nov 1969

Sets forth the criteria and order of precedence for the selection of specifications and standards to be used by design activities in the design construction of military material for the Department of Defense.

MIL-STD-280A, "Definition of Item Levels, Item Interchangeability, Models and Related Terms," 7 Jul 1969

Establishes standard terms and definitions to be used in describing the levels of military items and to designate and define item exchangeability, models and other related terms.

MIL-STD-454G, "Standard General Requirements for Electronic Equipment," Notice 3, 10 Sep 1981

Provides a technical baseline for the design and construction of electronic equipment including requirements for various types of components and for various other considerations such as safety, soldering, workmanship, etc.

MIL-STD-794D, "Parts and Equipment; procedures for packaging and packing of," Notice 5, 15 Oct 1981

Provides procedures for packaging and packing parts and equipment based on their material composition, surface finish, size, weight, fragility, configuration and the intended level of protection.

MIL-STD-881A, "Work Breakdown Structures for Defense Materiel Items," 25 Apr 1975

Describes the requirements for work breakdown structures.

MIL-STD-965, "Parts Control Program," Notice 2, 16 Feb 1981

Establishes the guidelines and requirements for implementation of a parts control program.

MIL-STD-1556A, "Government/Industry Data Exchange Program," 29 Feb 1976

Describes the contractor's participation in the GIDEP.

MIL-STD-1604, "Technical and Maintenance Overhaul Repair Standards; preparation of," Notice 2, Jan 1974

Delineates uniform requirements and criteria for the preparation of technical and maintenance overhaul and repair standards.

MIL-STD-1679, "Weapon System Software Development," 1 Dec 1978

Establishes requirements for the design and development of weapon system software applicable to government contracts.

MIL-STD-1695, "Working Environments, minimum standards for," 13 Sep 1977

Defines the minimum standards for working environments applicable to suppliers of military hardware.

2.8.3 SPECIFICATIONS

MIL-E-16400, "Electronic, Interior Communication, and Navigation Equipment," Amendment 1, 1 Dec 1976

Covers the general requirements applicable to the design and construction of electronic, interior communication and navigation equipment intended for naval ship or shore applications.

2.8.4 HANDBOOKS

NOSC TD 108, "Project Managers Guide," 1 Jun 1977

Provides guidance to the project manager in program planning and implementation including a discussion of life-cycle costing, integrated logistics support, documentation, contracting, test and evaluation, risk management and other topics of interest.

NOSC TD 250, "Suggestions for Designers of Navy Electronic Equipment," May 1979

Provides a design checklist for engineers involved in the development of Naval electronic equipment.

DOD-HDBK 248A, "Guide for Application and Tailoring of Requirements for Defense Materiel Acquisition," 15 Oct 1979

Outlines a methodology to be used in the application and tailoring of the requirements of standards and specifications.

<u>NAVSEA 0967-LP-490-1080</u>, "Undersea Warfare Systems Group Work Breakdown Structure for Shipboard Electronic Systems," 30 Jun 1975

Provides guidance for structuring a Project Summary Work Breakdown Structure (WBS) for shipboard electronic systems within the Undersea Warfare Systems Group. Based on MIL-STD-881. Compatible with Ship Work Breakdown Structure (SWBS) NAVSHIPS 0900-039-9010.

3. PRODUCT ASSURANCE PROGRAM

3.1. PROGRAM MANAGEMENT

3. PRODUCT ASSURANCE PROGRAM

3.1 PROGRAM MANAGEMENT

The NOSC Project Office shall establish and maintain an effective product assurance program to ensure that systems and equipment designed and developed by NOSC will be of high quality and will be reliable, maintainable, safe to use and logistically supportable when deployed in the operational environment. The applicable elements of this document shall be considered for inclusion in the product assurance program for each NOSC project whether such project is to be conducted in-house or is to be conducted by a contractor. Individual requirements selected from this document shall be appropriate to the type of project and to the project's phase in the life-cycle and shall be responsive to the requirements of the systems command sponsor as established in the NOSC tasking agreement. Individual requirements of the document should be tailored as required. Factors which influence the selection and the tailoring of requirements include:

a. Type of system being developed (e.g., weapon, fire control, communication equipment, surveillance system, etc.)

b. System's life cycle phase (i.e., conceptual, validation, full-scale development, production, operational)

c. System's production potential (i.e., limited or extensive)

d. Anticipated procurement plan (e.g., production of fleet hardware to be by the developer on a one-time sole-source basis or production to be on a competitive, industrial basis

e. Anticipated fleet utilization scenario (i.e., logistics support requirements)

f. Special requirements of the systems command sponsor

Section 3.1 contains an accumulation of product assurance management requirements which should be considered for applicability during development and production. As with the balance of this document it is stressed that not all the requirements of this section will be applicable to all projects and those that are applicable may require tailoring or modification.

3.1.1 MANAGEMENT POLICY

The NOSC project manager is considered to be totally responsible for his project, including provisions for planning and implementing an effective product assurance program. It shall be the prerogative of the project manager to determine whether the product assurance functions of the program are to be performed in-house, utilizing available NOSC or other laboratory personnel, or are to be performed under contract, either as a separate function or as part of a total contracted development or production task.

When the equipment is to be developed largely in-house, it is logical for the product assurance functions to be performed either by qualified NOSC

personnel or, if not available, by a qualified product assurance services contractor. When they are to be developed under contract, then the product assurance functions logically should be performed by the designated contractor with NOSC personnel assigned to monitor the contractor's efforts.

When the equipment development contractor will be required to perform the attendant product assurance functions, then those requirements sections identified in this document by an asterisk (*) should be considered for inclusion in the contract Statement of Work with any modification that might be necessary. Those product assurance elements for which recommended contractual statements are not provided, due either to the subject complexity or wide variation of the subject provisions, shall be established by the project office based on the project needs. However, guidance for formulating such requirements is provided in the introductory paragraph of the section and in those paragraphs entitled: (subject) Activities During Various Program Phases and Inclusion of Appropriate (subject) Requirements in Contracts. Guidance for establishing contractual requirements for various subjects also is provided in the attached appendices.

NOSCINST 4855.1 establishes policy and states requirements for NOSC's Product Assurance Program which is applicable to all Center projects.

3.1.1.1 Approval for Service Use Considerations

The decision to commit substantial resources to the production of a naval system is a key project milestone which receives maximum visibility within the Navy, the Department of Defense and the Congress. Crucial to the positive outcome of this decision is the determination that established requirements for operational effectiveness, operational suitability and operational supportability have been met. The following provides excerpts from NAVMATINST 4720.1A "Approval for Service Use of Systems, Equipments, Conventional Weapons and Expendable Ordnance" regarding the product assurance expectations for the system in connection with the granting of "Approval for Service Use (ASU)."

a. Reliability and Maintainability. "Full ASU will not be recommended/granted until the minimum (threshold) reliability and maintainability requirements of the approved Decision Coordinating Paper (DCP/NDCP) have been achieved in accordance with OPNAVINST 5000.46 and a planned maintenance system (PMS) has been developed."

b. Integrated Logistic Support (ILS) Planning. "Full ASU will not be granted until planning in conformance with NAVMATINST 4000.20B (ILS Planning Policy) has progressed to the point that there is assurance that all elements of logistics support will be available in an approved form upon delivery of the first production item to the fleet."

c. Technical Documentation. "Full ASU will not be granted until technical documentation necessary for support of the material has been identified and there is assurance that the technical documentation which has been validated by the contractor, verified by fleet personnel and corrected prior to printing will be delivered in approved form with the first deployed production item. Where designs were developed at government expense, certification shall

be made that engineering drawings and associated lists are in accordance with Level 3 Military Specification DOD-D-1000B."

d. Personnel Requirements for Fleet Operation and Maintenance. "Full ASU will not be granted until there is assurance that the operating and maintenance procedures can be carried out effectively by the numbers of personnel with the levels of skills anticipated to be available within the rates and ratings to be assigned these responsibilities."

e. Configuration Management. "Following action is required in accordance with NAVMATINST 4130.1A (configuration management):

(1) Product baseline established

(2) Product baseline controlled by contractual application of DOD-STDs-480 and 490

(3) Product configuration identification and status accounting procedures established with the appropriate inventory control point (SPCC, ASO)

(4) Configuration management plan, where applicable, updated to reflect current and planned CM implementation"

f. Safety. "Full ASU will not be granted until a safety program as required by NAVMATINST 5100.6A (System Safety Program; implementation of) and conforming to MIL-STD-882A (or revisions thereto) has been accomplished and documented during applicable acquisition phases leading up to ASU and adequate provisions are made for continuation of the safety program into the production and deployment phase. Additionally, when explosives, pyrotechnics or propellants are involved, explosives safety reviews by the Weapons System Explosive Safety Review Board (WSESRB) are required in accordance with NAVSEAINST 8020.6B (Naval Explosives Safety Program...) during development and prior to ASU..."

***3.1.1.2 Contractor's Product Assurance Program Management**

The contractor shall establish and maintain an effective product assurance program which complies with the requirements of the contract. Documented statements of policy shall form the basic guidelines and the internal company authority for establishing and maintaining the contractor's program. The organizational structure and lines of authority shall be described and documented. Specific responsibilities shall be assigned and action authorities clearly delineated. Personnel performing product assurance program functions shall have sufficient, well-defined responsibility, authority and organizational freedom to fulfill the requirements of the program, to identify and evaluate problems and to initiate, recommend or provide solutions. In structuring the organization it should be recognized that the program requirements apply to the total contractor organization and, therefore, are not solely the responsibility of any particular organizational element. However, the product

---

*Suitable for direct inclusion in a contract Statement of Work

assurance program shall be defined and responsibility identified to assure that all contractual requirements are established and maintained. Management shall regularly review the status and adequacy of the product assurance program for which they have designated responsibility.

3.1.2 PROGRAM PLANNING

The product assurance program should be established and maintained for each program phase:

a. Conceptual

b. Validation

c. Full-scale development (see Paragraph 3.1.2.2)

d. Production (see Paragraph 3.4.2)

e. Operational

The program should reflect Center policies (see NOSCINST 4855.1 "NOSC Product Assurance Program") and procedures augmented as necessary to meet the requirements of the program and its planning should establish responsibilities and provide the methods and criteria for performing the applicable functions.

*3.1.2.1 Product Assurance Program Planning

The contractor's planning shall include normal company procedures and instructions augmented as necessary to meet the requirements of the contract. These procedures and instructions shall be complete and concise, of a type appropriate for the operation or task and shall define the responsibilities and provide the methods and criteria for performing the applicable functions. The planning and documentation shall:

a. Demonstrate an awareness, recognition and organized approach to the achievement of product assurance requirements

b. Assure that product assurance program requirements are determined and defined and that adequate controls are established and maintained throughout all phases of contract performance

c. Assure timely actions and smooth transition of the program throughout all phases of contract performance

d. Assure that quality, reliability, maintainability, safety, producibility, human engineering and other performance aspects are inherent in the design, specified in the design disclosure and procurement documentation and maintained during production and operational support

---

*Suitable for direct inclusion in a contract Statement of Work

e. Provide for prevention and detection of problems that should result in unsatisfactory performance and the initiation of timely and effective corrective action

f. Provide objective evidence of the effective implementation and operation of the product assurance program. Results of program reviews, audits, analyses, assessments, examinations and inspections performed shall be recorded and readily available for project office/sponsor review.

3.1.2.2 Program Plan

The Product Assurance Program Plan describes the reliability, maintainability, availability, system safety, human factors, quality assurance (hardware and computer software), configuration management (hardware and computer software) and Integrated Logistics Support activities which are required to be performed by the contractor in connection with the development or production of equipment or systems. This plan, which should have NOSC approval prior to implementation, is used to:

a. Evaluate the contractor's overall planning for the product assurance program as required by the contract, including those provisions to ensure the effective coordination and integration of related activities.

b. Identify the overall schedule to accomplish the principal product assurance activities.

c. Monitor the effective accomplishment of the program.

Paragraph 3.1.2.2.1 provides a suitable contractual requirement for a product assurance program plan for a project in the full-scale development phase.

*3.1.2.2.1 Product Assurance Program Plan

A product assurance program plan, CDRL item number (specify), shall be prepared to indicate the means whereby compliance with the product assurance requirements of the contract will be accomplished. The product assurance elements to be addressed in the plan, to the extent applicable, are: reliability, maintainability, availability, system safety, human factors, quality assurance (hardware and computer software), configuration management (hardware and computer software) and integrated logistics support. The plan shall include the following:

a. The Product Assurance Program Plan (PAPP) shall identify the overall plan for fulfilling the various contractual product assurance requirements as expressed in the contract Statement of Work.

b. The PAPP shall provide a brief general summary of each of the individual product assurance program elements (reliability, maintainability, availability, system safety, human factors, quality assurance (hardware and

---

*Suitable for direct inclusion in a contract Statement of Work.

computer software), configuration management (hardware and computer software) and integrated logistics support which comprise the program. Reference shall be made to those individual plans which provide the details of these elements.

c. The PAPP shall outline the plans, procedures, methods or techniques for conducting a comprehensive, fully integrated product assurance program which optimizes the efforts of each program element.

d. The PAPP shall include a master schedule showing the interrelationship between the product assurance program elements and indicating the expected completion of various product assurance data items as specified on the DD 1432.

e. The PAPP shall provide a cross index showing the relationship between program tasks, applicable standards and specifications, reference documents, contractor policies, instructions and procedur .

f. The PAPP shall be appropriate to the system complexity (hardware and computer software).

g. The PAPP also shall include:

(1) A listing of the company standards, policies, procedures and individual product assurance element program plans (e.g., quality assurance program plan), which will be followed in connection with the product assurance program.

(2) A listing of reference documents.

(3) A chart showing the product assurance organization which identifies those individuals (by name) who are responsible for the various program elements.

(4) A chart showing the expected personnel level-of-effort for each product assurance program element as a function of time.

(5) Plans for the training and certification of personnel, as appropriate.

(6) Plans for audit of product assurance program performance.

3.1.3 PROGRAM TECHNICAL DATA REQUIREMENTS AND MANAGEMENT

Once it is decided to proceed to the next development phase or into production or such a decision can be anticipated, copies of the proposed contract Statement of Work for the follow-on effort should be forwarded to the project's product assurance task team members to generate appropriate technical data requirements. This "data call," as it is referred to in NAVMATINST 4000.15A, (Department of the Navy Data Management Program), is an essential step in determining what technical data (see Paragraph 1.4 - Definitions) products are needed to permit the project to enter the following phase or to receive approval for service use (ASU) (e.g., various product assurance elements, program plans, analyses, procedures, engineering drawings, specifications, computer software, technical manuals, etc.). The task of generating

these data requirements should be performed by personnel who are knowledgeable in the particular product assurance field and the system to be developed or produced. When an individual concludes, as ultimately must happen, that the principal products of a research and development activity are items of technical data intended for a specific purpose (e.g., continued development, production or fleet operation), then the importance of project technical data requirements planning becomes clear.

The product assurance documentation requirements check list of Appendix B provides a summary of those related documents which typically are required in connection with a major development effort and which normally are submitted to the NOSC project office for formal review and approval. It is noted that suggested Data Item Descriptions (DD-1664) are included in Appendix B for those documents listed.

In accordance with NAVMATINST 4000.15A, all items of technical data required to be submitted by the contractor, whether for approval or for information, must be listed on the contract data requirements list (DD-1423) with an appropriate Data Item Description (DD-1664) cited. DOD 5000.19L, "Acquisition Management Systems and Data Requirements Control List (AMSDL)" lists all DOD approved DD-1664s; it is from this list that contract data requirements should be selected. Also, the DD-1423 form is annotated to indicate, among other things, if a technical data item requires advance written approval by the government and if the technical data item is to be delivered under a DD-250 material inspection and receiving report form, which requires formal government inspection and acceptance, or under a simple letter of transmittal. It is recommended that the more significant technical data items be submitted for advance review and approval and be accepted under a DD-250, particularly if the data item will be utilized in a subsequent contractual effort or will be provided to the fleet. NAVMATINST 4000.15A requires that engineering drawings, specifications and related data (e.g., technical manuals) always be accepted under a DD-250. NAVMATINST 4000.15A provides instructions for completing the DD-1423 form.

Since a considerable amount of technical data is generated in connection with major programs, particularly during the validation and full-scale development phases, it is advisable to assign a technical data manager to the project. The technical data manager's function would be to:

a. Receive and account for all contractor (or other) generated technical data inputs (documents)

b. Ensure the review of those documents, by appropriate specialists, for technical content and conformance to the specified standards and specifications

c. Coordinate the Center's response to the contractor, or SYSCOM, regarding those documents; this is a substantial task and its importance should not be overlooked or minimized

***3.1.3.1 Product Assurance Program Documentation**

Product assurance program documentation shall be prepared and maintained as specified on the contract data requirements list (DD-1423). Additionally, the contractor shall maintain a status chart of all program documentation showing the required completion dates, dates for submittal for advance approval, if required, etc.

3.1.4 EDUCATION, TRAINING AND CERTIFICATION OF PERSONNEL

When product assurance functions are intended to be performed by contractor personnel, particularly those employed by a prime contractor, it is advisable to include an education and training program requirement. Likewise, it is advisable to include a requirement for certification of personnel who will perform critical processes.

***3.1.4.1 Education and Training**

A training program shall be established and maintained for personnel whose activities have an effect on the quality, reliability, maintainability, human engineering or safety of the product. Education programs shall be oriented towards the integration of existing engineering and management skills to emphasize the design and manufacturing disciplines and techniques by which reliable products are assured. Training, including on-the-job training, shall be conducted when necessary to meet specific requirements. Particular emphasis shall be given to new products and new, sensitive, complex or hazardous manufacturing processes or materials. Training shall include pertinent subjects such as: design techniques, product familiarization, test equipment familiarization, processing and manufacturing techniques and methods, quality control methods and systems, statistical quality control and packaging and handling techniques. Training programs shall have a means of measuring the effectiveness of the program and shall maintain records of completed courses. Training needs shall be assessed periodically to determine requirements for additional training.

***3.1.4.2 Certification of Personnel**

Contractor personnel responsible for manufacture, inspection, test or control of processes, operations and equipment which require highly specialized skills shall be certified prior to performing these functions. Certification of personnel for these skills in such functions as nondestructive testing, welding, soldering, bonding, welded circuits and integrated circuit fabrication shall include a training program and a testing procedure to assure proficiency. Objective evidence of certification shall be maintained. The period of effectivity shall be specified and recertification shall be performed prior to expiration. Individuals failing recertification shall be removed from the operation involved until the tests are successfully completed and the individuals are certified as proficient in the required skills. Results of inspections, surveillance and quality audits shall be used as

---

*Suitable for direct inclusion in a contract Statement of Work

indicators of the need for additional training and recertification of personnel without regard to established periods. Personnel who for longer than six months have not performed the work for which they were certified also shall require recertification. The contractor shall establish and maintain a list of special skills and personnel certifications.

3.1.5 AUDIT OF PRODUCT ASSURANCE PERFORMANCE

A NOSC in-house conducted product assurance program generally would not require auditing. However, scheduled internal audits of a contractor's own program often are appropriate with large systems development efforts and should be required because the NOSC project manager generally lacks visibility of the contractor's operation.

*3.1.5.1 Audit Conduct

The product assurance program audits shall be conducted on a scheduled basis. They shall be planned and performed by an independent audit group or by a team of product assurance personnel not having direct responsibilities in the areas to be audited. Personnel performing audits shall be appropriately trained and qualified in product assurance audit techniques, practices and reporting. The audits shall consist of a review of both product assurance program elements and product conformance. Program element audits shall include verification of adequacy and implementation of policies, procedures and instructions controlling the applicable product assurance requirements for all contract phases. Product conformance audits shall include:

a. Review of the individual product assurance program elements (reliability, maintainability, quality, safety, human engineering) plans to verify that plans are being followed and that progress is consistent with schedule requirements

b. Random reinspection and test of products accepted at all stages of manufacturing, processing and assembly

c. Checks for availability of required documents and records

d. Determination of personnel's familiarity with the required documents

e. Adequacy and compliance with process controls and related procedures

f. Adequacy of training and certification of personnel

Audits shall be conducted using prepared procedures or checklists to assure complete and consistent evaluations.

*3.1.5.2 Audit Report and Corrective Action

The results of each audit shall be covered by a report to affected managers and supervisors. Management shall take action to assure that deficiencies are corrected immediately. Summaries of product assurance audits and

---

*Suitable for direct inclusion in a contract Statement of Work

the corrective actions taken shall be prepared and distributed to contractor management. Follow up audits shall be conducted to assure that corrective actions are adequate and implemented for each deficiency.

3.1.6 INTEGRATED DATA SYSTEM

An integrated data system can be a useful product assurance tool when applied to a large system development program but seldom would it be cost effective for the small project. In addition, it could be a useful means of reviewing the contractor's efforts.

*3.1.6.1 Product Assurance Data System

An integrated data system shall be established and maintained for the effective collection, control, processing and use of quality, reliability, maintainability and safety data. Such design data shall be collected to support:

a. Design engineering and the preparation of the design disclosure documentation

b. Quality, reliability, maintainability, system safety and integrated logistics support programs

c. Configuration management

d. Material, component and equipment nonconformance reporting and corrective action system.

The data system shall:

a. Identify information needs

b. Coordinate and integrate data inputs and outputs to ensure that information needs are being met in the most economical manner

c. Ensure the effective distribution, utilization, storage and maintenance of data

The integrated data system shall be documented to include:

a. Source, purpose and use of data

b. Collection, processing, storage, maintenance and retrieval systems

c. Forms and formats for data reporting

d. Data summary reports to be generated and their distribution

---

*Suitable for direct inclusion in a contract Statement of Work

3.1.7 PROBLEM/FAILURE REPORTING, DATA COLLECTION AND ANALYSIS AND CORRECTIVE ACTION

Regardless of program size, a system should be established and maintained during all program phases that will assure:

a. Reporting of NOSC or contractor discovered equipment or computer software problems and failures

b. Integration of fleet or other activity discovered equipment problem/failure data

c. Analysis of failed hardware and computer software reporting of analysis results

d. Initiation of necessary corrective action

The system should strive to include problem/failure data available from all sources. Problem failure data should be recorded as completely and comprehensively as possible to provide an accurate data base for investigation and analysis.

*3.1.7.1 Problem/Failure Reporting

Discrepancies shall be documented at the time of the discovery and the information shall include complete identification of the item and conditions experienced. Problem/failure data shall be reported without regard to cause or probable cause and shall provide for the recording of:

a. Listing of each failure

b. Problems resulting from incorrect or inadequate documentation

c. Problems discovered during acceptance test and inspection

d. Problems which are repetitive in nature and can affect quality, reliability, maintainability or safety

*3.1.7.2 Problem/Failure Investigation and Analysis

Problems/failures shall be investigated to determine seriousness and need for analysis and/or corrective action.

a. Investigation shall include:

(1) Classification of the problem/failure as critical, major or minor and determination as to whether or not safety is affected.

(2) Review of the problem/failure to determine the type and extent of analysis required

---

*Suitable for direct inclusion in a contract Statement of Work

(3) Review of previous data to determine if there have been similar problems or failures and to detect trends

b. Analysis shall include:

(1) Determination of probable cause of the deficiency

(2) Examination and test of the deficient item as appropriate

*3.1.7.3 Corrective Action

Where corrective action is required on problems/failures, it shall be taken and documented to include:

a. Action recommended or planned with schedules for accomplishment, verification and close out and organizational responsibility assignments

b. Accomplishment of the necessary action

c. Follow-up to assure completion and effectiveness of corrective action

3.1.8 TECHNICAL DATA QUALITY ASSURANCE PROGRAM

Wherever technical data (see Paragraph 1.4 - Definitions) are contractor prepared, a program should be established and maintained to control the quality of those technical data, particularly with regard to engineering drawings and specifications, technical manuals and computer software. The technical data quality program should be documented as part of the product assurance program plan.

*3.1.8.1 Technical Data Quality Program

As part of his product assurance program, the contractor shall institute a technical data quality program including the following elements:

a. Designation of authority and responsibilities for the preparation and submittal of technical data

b. Documentation of the plan to provide for an organized approach in determining and achieving quality requirements for technical data

c. Development and implementation of methods and procedures to assure that technical data are developed in accordance with contract requirements

d. Provisions to prevent and detect problems and initiate timely and effective corrective action

e. Provisions to document the effectiveness of implementing and operating the program; results of review, evaluations, inspections, etc., shall be made available to program management on request

---

*Suitable for direct inclusion in a contract Statement of Work

3.1.9 CONTRACTOR USE OF GOVERNMENT-FURNISHED MATERIAL OR EQUIPMENT

When material or equipment is furnished to a contractor by the government, the contractor should be required to verify that the material or equipment is complete, undamaged and operational. Additionally, the contractor should be required to ensure that it is protected and maintained while under the contractor's control.

*3.1.9.1 Government-Furnished Material or Equipment

The contractor shall perform the following regarding all government furnished material/equipment (GFM/GFE):

a. Examination upon receipt, consistent with the ability to detect damage in transit

b. Inspection for completeness and proper type

c. Verification that documentation specified is available

d. Verification of quantity

e. Periodic inspection and precautions to assure adequate storage conditions and to guard against damage from handling and deterioration during storage

f. Functional testing as required to determine satisfactory operation

g. Physical identification and protection from improper use or disposition

GFM/GFE, found damaged, malfunctioning or otherwise unsuitable for use or incorrect quantity, shall be reported to the local government representative. In the event of damage or malfunctioning during or after installation, the contractor shall determine and record probable cause and necessity for withholding material from use. No repair, modification or other tampering with the GFM/GFE shall be permitted without written authorization of the government representative and an approved method of work, inspection, test and acceptance of the defective material. In addition, the contractor shall comply with the provision of Defense Acquisition Regulation (DAR) Appendix B in handling government property.

3.1.10 SAMPLING TECHNIQUES

The use of sampling techniques for the acceptance of large quantities of homogeneous material, produced at the same time and under the same processing conditions, is an accepted practice. Sampling is not appropriate, however, whenever a risk of accepting defective components or material cannot be tolerated. In such cases, 100 percent inspection is appropriate and should be

---

*Suitable for direct inclusion in a contract Statement of Work

specified on the contract or, preferably, on the drawing describing the particular component or equipment. See Paragraph 3.1.19.1.4 and Appendix L for recommended sampling requirements for provisioning parts.

*3.1.10.1 Use of Sampling

Sampling plans may be used when historical records, inherent characteristics of the article or the application of the article indicate that inspection can be reduced without jeopardizing quality or reliability. Sampling inspection shall be in accordance with applicable military standard sampling plans (i.e., MIL-STD-105, MIL-STD-414) or approved alternates. If an alternate sampling plan is used, it shall be documented in detail to show factors such as the lot size, sample size, accept/reject criteria, operating characteristic curves and criteria for reduced or tightened inspection. Alternate sampling plans shall be approved by the procuring activity prior to use.

3.1.11 QUALITY COST DATA

At times, particularly in connection with large production efforts, the knowledge of quality costs will be useful to the Project Manager.

*3.1.11.1 Collection of Quality Cost Data

Quality cost data shall be collected, maintained and used as a management element of the product assurance program. These data shall identify the cost of preventing and correcting nonconforming items, including the cost of labor and material in the spoilage caused by defective work. The specific quality cost data to be collected and used shall be identified on request and made available for on-site review by the local government representative and/or the government Project Manager.

3.1.12 CONFIGURATION MANAGEMENT PROGRAM (HARDWARE)

Configuration management is a management technique designed to:

a. Properly identify functional and physical characteristics of an item

b. Control identification and changes to the characteristics

c. Record change processing and implementation status throughout the life cycle of the item

A well planned, well documented and disciplined configuration management (CM) program for both hardware and computer software (refer to Paragraph 3.1.13) is absolutely essential to the success of military equipment development or production. The CM requirements for hardware vary considerably, depending on the program phase and several other factors. The DOD CM policy document, NAVMATINST 4130.1A, "Joint DOD Services/Agency Regulation - Configuration Management," states that the CM requirements should be consistent with the objective of the program/project at the particular point in its life

---

*Suitable for direct inclusion in a contract Statement of Work

cycle. Table 3.1 provides an overview of the various CM baselines as they relate to the life cycle phase of the equipment.

In the following, those elements which comprise CM, i.e., configuration identification, control and status accounting, are discussed, as well as the configuration audit process.

3.1.12.1 Configuration Identification

Configuration identification is established in the form of technical documentation (drawings, parts lists, specifications, etc.). This identification becomes more detailed as design and testing progress. Configuration identification is applicable to all hardware items and to computer software programs and their associated documentation (refer to Paragraph 3.1.13). This identification also will be the basis for the preparation of other technical, administrative and management documents (i.e., work breakdown structures, technical reports, provisioning, lists, etc.) that relate to or depend on a configuration item's (CI) configuration. Configuration identification is the basis for configuration control and status accounting during the equipment life cycle.

The specification is an important item of technical documentation associated with configuration identification. At the beginning of development, the Type A system specification (MIL-S-83490) describes the technical and mission requirements for the system as an entity and forms the basis for the initial design. Later, Type B development specifications are generated detailing the requirements for the design of the products during full scale development. Finally, Type C product specifications, which are of either the function or fabrication (detailed design) type, are developed in conjunction with the product design effort. During product development it is most important that the structuring of the specifications be closely aligned with the intended method for procurement of the CIs involved. It is noted further that the intended method for procurement of a CI must be aligned closely with the plan for its logistics support.

3.1.12.1.1 Functional Baseline

The functional baseline is a product of the conceptual phase effort. Functional configuration identification should be required of designated CIs since such identification will serve to provide a description of the item's functional characteristics. Either Type A (system) or Type B (development) specifications, supplemented by Level 1 (conceptual and developmental) engineering drawings (see Paragraph 3.1.19.1.1), is used, as necessary to provide:

a. All essential system functional characteristics

b. Necessary interface characteristics

c. Specific designation of the functional characteristics of key configuration items

d. Those tests necessary to demonstrate achievement of the specified characteristics

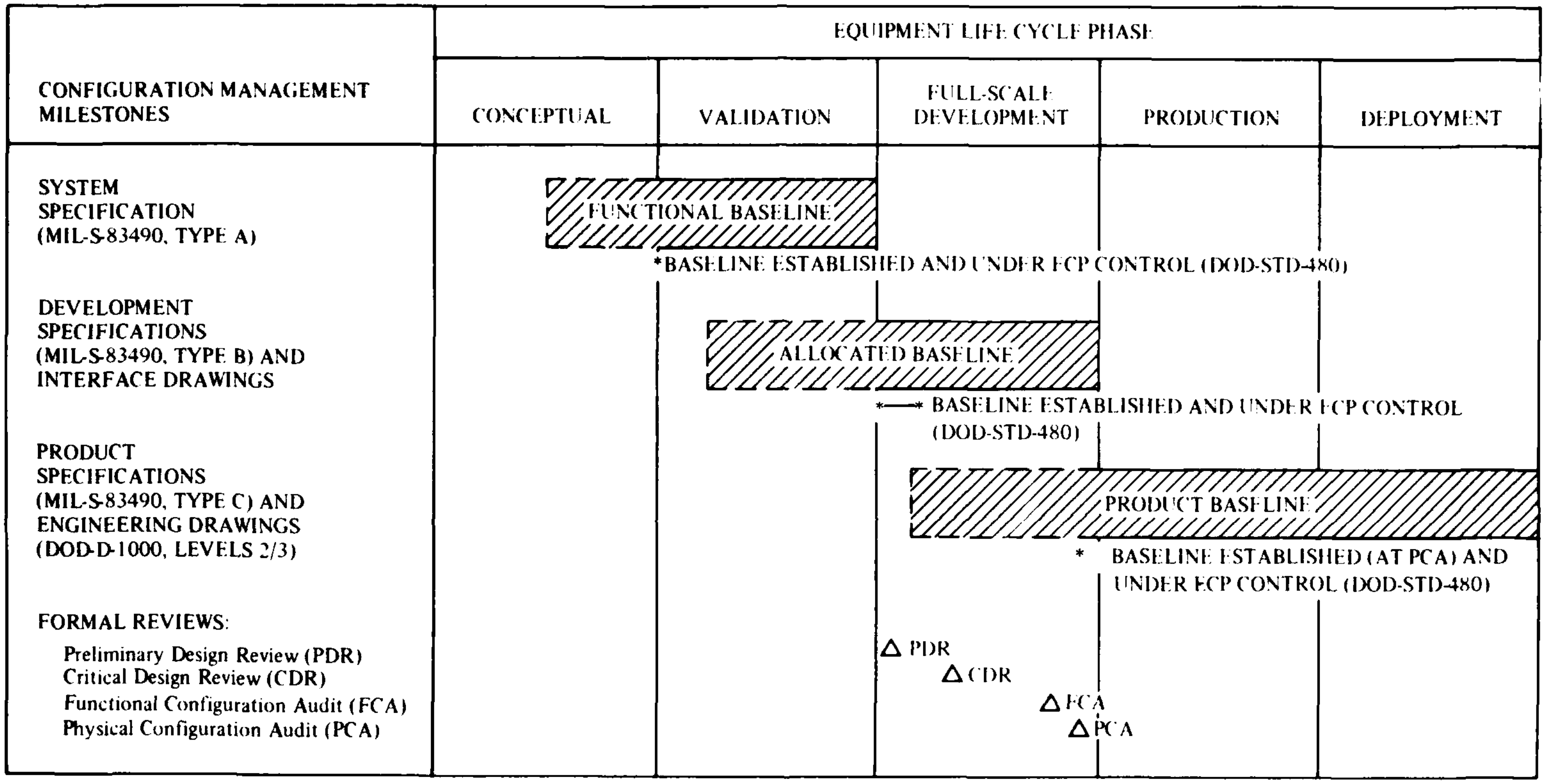


Table 3.1. Configuration management baselines and events related to the life cycle phase of the equipment.

3.1.12.1.2 Allocated Baseline

The allocated baseline is a product of the validation phase. Allocated configuration identification normally consists of a series of Type B (development) specifications (supplemented by Level 1 and/or Level 2 (production prototype) engineering drawings as necessary), defining the functional requirements for each major CI as necessary to provide:

a. All the essential functional characteristics, including delineation of interfaces

b. Physical characteristics necessary to assure compatibility with associated systems, other CIs and inventory items

c. Those tests required to demonstrate achievement of each specified functional characteristic

3.1.12.1.3 Product Baseline

The product baseline is generated near or at the conclusion of the full-scale development phase, although an initial product baseline (see Appendix D, Paragraph 4.1.2) may be established earlier in the phase as a means for exercising better control over the design effort during the final stage of development. Product configuration identification normally includes specification Types C (product), D (process) and E (material) and Level 2 (production prototype and limited production) and/or Level 3 (production) engineering drawings, associated lists and related data. The product configuration identification is expected to provide a set of documents adequate for the procurement, production, test, evaluation and acceptance of an item without the necessity for additional development effort. The type of specifications and the level of the engineering drawings to be provided should be established in consideration of and in full agreement with the anticipated method of procurement and logistics support. Paragraph 3.1.19 provides guidance for selecting the appropriate engineering drawing level.

3.1.12.2 Configuration Control and the Configuration Control Board

Configuration control consists of the systematic evaluation, coordination, approval or disapproval and implementation of all approved changes in the configuration of a configuration item (CI) after formal establishment of its configuration identification. Such changes include engineering change proposals (ECPs), specification change notices (SCNs) and waivers and deviations (W/Ds) and informal contractor equivalent documents. The type and extent of configuration control to be exercised in a program should be appropriate to each particular stage of the program. During the early phases of the program the control should be limited to the major program documents such as the various system or equipment specifications. During full scale development configuration control generally is increased to the point where at the end of this phase, when the product baseline is issued, all CIs comprising the system are under total configuration control. During production there always must be total configuration control, i.e., all variations from the product baseline must be recorded and must have been approved by the government. Usually, the configuration control responsibility during production is shared

between the SYSCOM program office, the NOSC project office and the DCAS. A generally workable arrangement for sharing the configuration control review and approval responsibilities in a program is as follows.

a. Class I ECPs, Critical and Major Deviations and Waivers

- o DCAS reviews for accuracy of stated data on deviations and waivers
- o NOSC reviews for technical acceptability and recommends action to SYSCOM
- o SYSCOM approves/disapproves

b. Class II ECPs

- o DCAS reviews for classification
- o NOSC approves/disapproves
- o SYSCOM informed of action by copy

c. Minor Deviations and Waivers

- o DCAS approves/disapproves based on a revocable redelegation from NOSC
- o NOSC informed of action by copy
- o SYSCOM informed of action by copy

When reviewing changes, it is important to ensure that all project interests (i.e., reliability, maintainability, system safety, logistics support, etc.) are considered. Consequently, the configuration control program should include participation by all disciplines wherever appropriate. Some projects utilize formal Configuration Control Boards (CCBs) where the appropriate representatives from project management, engineering, reliability, quality assurance, logistics and possibly other disciplines (e.g., system safety) meet as a body to discuss and act on changes. Other projects accomplish the same purpose through a series review process. Either method is satisfactory, providing the proper reviews are obtained. DOD-STD-480 "Configuration Control - Engineering Changes, Deviations and Waivers" describes the preparation of ECPs, deviations and waivers.

3.1.12.3 Configuration Status Accounting

Configuration status accounting provides traceability of configuration baselines and changes thereto and provides a management tool for accomplishing all related tasks resulting from such changes. Status accounting data and reports, which generally are computer generated, may exist in any one of several formats. The structure and mechanization of the status accounting function are dictated by the program's needs, the number of configuration

items (CIs) involved, the change activity and any special constraints that may have been imposed.

3.1.12.4 Configuration Audits

Configuration audits are the means whereby the design is determined to comply with specifications and other contract requirements. Typically conducted near the end of full-scale development, the configuration audit validates accomplishing the development objectives and requirements and attaining a production configuration as detailed in the engineering documentation. Configuration audits should include a functional configuration audit (FCA) and a physical configuration audit (PCA). These vary as to the type of CI development (i.e., CIs developed at government expense or CIs developed privately). Wherever practicable and appropriate, configuration audits should be accomplished in conjunction with other audits, reviews, demonstrations/service tests, inspections, acceptance trials or other test/evaluation program requirements.

3.1.12.4.1 Functional Configuration Audit (FCA)

This audit is a means of validating that development of a CI has been completed satisfactorily with regards to its performance or function. This is a prerequisite to the physical configuration audit (PCA). FCAs are conducted on CIs to assure that the CIs technical documentation accurately reflect CIs functional characteristics as well as those necessary physical characteristics and that test/analysis data verify that the CIs have achieved the performance specified in their functional or allocated configuration identifications. MIL-STD-1521 Appendix E provides a detailed description of the FCA.

3.1.12.4.2 Physical Configuration Audit (PCA)

This audit is a means of establishing the product baseline as reflected in the product configuration identification which eventually will be used for the fabrication and acceptance of production units. The audit has two purposes. The first is to assure that the "as-built" configuration of the CI, usually the first prototype fabricated, matches the product configuration identification (drawings, etc.) for the unit, or that differences are reconciled through identifying approved engineering changes, deviations or waivers. The second is to assure that the prescribed acceptance testing requirements are adequate for quality assurance acceptance of production units. Any difference between the physical configuration of the PCA unit and the FCA unit must be identified and recorded; it is important to demonstrate that these differences do not degrade the functional characteristics of the unit. Whenever possible, the FCA and the PCA audits should be performed on the same unit. MIL-STD-1521 Appendix F provides a detailed description of the PCA.

3.1.12.5 Configuration Management Activities During Various Program Phases

3.1.12.5.1 Conceptual Phase

During the conceptual phase the CM activity is limited strictly to the identification and control of the general operational characteristics requirements documents which form the basis for the program.

3.1.12.5.2 Validation Phase

During the validation, or advanced development phase, the CM activity consists generally of the identification and control of specific operational and functional characteristics requirements documents. Certain hardware CIs may be subject to configuration management, but in such cases only the minimum necessary constraints (i.e., performance and interface requirements) should be imposed and these should be consistent with the objectives of the specific program.

3.1.12.5.3 Full-Scale Development Phase

During the full-scale, or engineering development phase, the CM activity begins with the control of the system development specification and the system interface control drawings. It ends with the identification and control of all system components or CIs. Beginning with his release of the design of a CI for purchase or fabrication, the contractor should maintain total CM over that CI until the development effort is completed. This should include the completion of the technical and operational evaluation tests, assuming the contractor will be involved in the engineering activity associated with these, as is often the case.

Depending on the nature of the equipment, at some point in the phase the development contractor should establish an initial or preliminary product baseline, i.e., a complete listing of the documents (drawings, parts lists, specifications, etc.) describing all system CIs. A logical time to do this is just prior to performing the functional and physical configuration audits described in Paragraph 3.1.12.4. From the time these audits are completed, the NOSC project office should review all contractor requests for engineering changes, both of the Class I and Class II type discussed in DOD-STD-480. The NOSC project office also, from that time on, should review all contractor requests for critical and major deviations and waivers. Whether the NOSC project office or the local Defense Contracts Administration Services (DCAS) representative would review and approve minor deviations and waivers would depend on the nature of the program, the anticipated production plan and the technical competence of the DCAS representative. The final product baseline, resulting from the development and to which production hardware would be fabricated, logically would be issued after the technical and operational evaluations were complete and the attendant technical problems were resolved. The final product baseline should be validated independently by the NOSC project office.

3.1.12.5.4 Production Phase

During the production phase, CM is highly formalized and follows a strict discipline. As part of the production contract specification, the contractor is furnished the product baseline which was established at the completion of full-scale development and is required to fabricate in accordance with that baseline. During production, the contractor must obtain approval of all variations from the product baseline through the engineering change proposal (ECP) and deviation and waiver process and must maintain strict accounting of these. Finally, a good program of CM should require that the contractor furnish at the time of government acceptance an "as built" configuration

listing identifying the exact baseline and including all approved engineering changes and all critical and major deviations and waivers to which the equipment was fabricated. While the contractor should be required to maintain strict accounting of the status of all CIs, so should the NOSC project office; the government always should have independent knowledge as to what changes, etc., the contractor has been authorized to fabricate to under his contract.

3.1.12.5.5 Deployment Phase

During the deployment or the operational phase, configuration management (apart from that relating to ongoing production) usually consists of three general areas of activity:

a. Configuration management of fleet equipment assets to provide a suitable system to track the replacement of major equipment components; such a program is of decided value if major retrofit or modernization programs are anticipated

b. Configuration management to support depot maintenance and repair operations; "as built" historical records should be preserved for this

c. Configuration management to support ship parts control center or other spare parts replacement operations; establishes proper baselines to procure spare parts and manage any spare parts contractors' change control activity

3.1.12.6 Inclusion of Appropriate Configuration Management Requirements in Contracts

Configuration management (CM) requirements vary considerably from phase to phase and differ widely, depending on the size of the project, the nature of the equipment and the relative responsibilities of the various program participants (SYSCOM Headquarters, NOSC, other Navy or DOD activities, DCAS, etc.). Paragraph 3.1.12.6.1 provides a recommended contractual requirement for a configuration managment program for small to moderate size projects in the full-scale development phase. Paragraph 3.1.12.6.2 and Appendix D provide an example of a CM program requirement for a major system full-scale development effort. Appendix E provides an example of a CM program requirement for a major system production effort. In some program phases, particularly full-scale development and production, the CM requirements frequently comprise a major section of the contract.

The Appendix D and E examples are provided to show how the various CM program requirements elements may be addressed and structured and do not intend to imply that their provisions are in any way mandatory or are even typical.

When planning contractual CM requirements, it is expected that the objectives of the program will be consistent with the policies and guidance outlined in NAVMATINST 4130.1A which is the joint DOD Services/Agency regulation on CM. In establishing contractual CM program requirements the responsibilities of the SYSCOM program office, the NOSC project office, the DCAS and any other government agency and those of the contractor should be clearly

defined. Regardless of the program size or of the extent of the CM program provisions, the contractor always should be required to submit a CM plan for government approval. This plan provides a means of establishing that the contractor clearly understands the contractual requirements and has planned an appropriate system for their implementation. Preferably, the main elements of this plan should be submitted with the contractor's proposal.

Additionally, appropriate baselines should be employed throughout the life cycle of a system or equipment to ensure an orderly transition from one major commitment point to the next in the system engineering, production and logistic support processes. Baselines should be established at those points in a program where it is necessary to define a formal departure point for control of future changes in performance, design, production and related technical requirements.

Although there is a natural order of CM events and actions during the life cycle of a CI, the CI's specific functional/physical characteristics or special program requirements may necessitate certain variations. For example, in the validation phase, the functional and/or allocated baselines should be as flexible as possible to avoid undesired, premature commitment to specific detailed performance requirements. The initial configuration identification could well be a range of proposed broad system performance parameters/characteristics. Such a preliminary system description may be used to facilitate the evaluation of alternative design approaches as major system performance specification/cost trade-offs are made.

In the following, recommended contractual requirements statements are provided which cover the contractor's establishment of a configuration management program for small to moderate size projects (Paragraph 3.1.12.6.1) in the full-scale development phase and for major projects (Paragraph 3.1.12.6.2) in either the full-scale development (Appendix D) or production (Appendix E) phases.

***3.1.12.6.1 Configuration Management Program (For Small Projects)**

The contractor shall establish a Configuration Management Program described by a plan documented in accordance with CDRL item number (specify) which incorporates the following elements:

a. Submittal to NOSC, for approval, of any proposed changes to the (name) system development specification (specify number) or to any other document (e.g., interface control drawings) which constitute the functional baseline for the system development. Such proposed changes are to be documented as Class I Engineering Change Proposals prepared in accordance with DOD-STD-480, per CDRL item number (specify).

b. Definition and control of design changes and the equivalent of deviations and waivers in accordance with established company policy during the initial design phase of the contract and up to the time of initiation of

---

*Suitable for direct inclusion in a contract Statement of Work.

the Physical Configuration Audit (PCA). No critical deviations or waivers are permitted without NOSC concurrence. (See DOD-STD-480 for definitions.)

c. Definition and control of design changes (Class I and II ECPs), critical and major deviations and waivers in accordance with DOD-STD-480 for all changes initiated during and following the PCA. Such changes are to be submitted to NOSC for approval, per CDRL item number (specify). Following the PCA, minor deviations and waivers may be approved by the contractor's Material Review Board upon DCAS concurrence as to classification.

d. Maintenance of configuration management action listings showing the initiation, submission and approval status of all contractor design changes (Paragraph b, above), Class I and II ECPs and critical, major and minor deviations and waivers.

e. Maintenance of a listing, referred to as the baseline, of that approved documentation which delineates the physical and functional characteristics of each system element (configuration item). The baseline shall include all drawings, drawing lists, specifications and approved changes affecting these documents which constitute the current configuration identification of the system. The baseline, CDRL item number (specify), shall be maintained on a continuous basis beginning with the release to fabrication or procurement. At the time of initiation of the PCA the baseline is designated as the "Initial Product Baseline (IPB)" and from that time on may not be modified except where NOSC has approved ECPs pertaining to those documents included in the IPB. The final Product Baseline, to be approved by NOSC at or near the end of the development effort, is established upon incorporation of all changes (ECPs) resulting from TECHEVAL/OPEVAL and upon NOSC final approval of the individual drawings, drawing lists and specifications included in that baseline.

f. Maintenance of an "as built" configuration status accounting listing, providing serial number effectivity accounting for all contractor approved design changes (up to PCA), for all Class I and II ECPs (during and after PCA) and for all critical and major deviations and waivers throughout the life of the contract. A separate listing shall be provided for each prototype system fabricated. Serial number accounting requires the identification of the next highest serialized assembly in those instances where the affected item is not serialized.

g. Performance of a Functional Configuration Audit (FCA) in accordance with Appendix E of MIL-STD-1521 to verify compliance with the system development specification (specify number).

h. Performance of a Physical Configuration Audit (PCA) in accordance with Appendix F of MIL-STD-1521 to verify compliance of the "as built" prototype with the initial product baseline (Paragraph e, above). All discrepancies identified shall be recorded and resolved, as directed by NOSC, in the following manner:

(1) Where the baseline document (drawing or specification) is considered to be correct and complete, differences noted in the hardware either

will be corrected or, if not functionally significant, will be recorded by a waiver prepared in accordance with DOD-STD-480.

(2) Where the hardware item is considered to be correct, discrepancies or lack of requirements noted in the baseline document will be addressed by an ECP prepared in accordance with DOD-STD-480.

i. The FCA and the PCA will be performed by the contractor under the direction of a designated NOSC project representative. Audit agendas and reports will be provided in accordance with CDRL item numbers (specify).

j. Establishment of a Parts Control Program in accordance with Procedure I of MIL-STD-965. In connection with this program the contractor shall submit a Program Parts Selection List (PPSL) in accordance with CDRL item (specify). Non-standard parts requests are to be submitted to NOSC for approval, in accordance with CDRL item (specify). The program shall be tailored to the minimum needs of the program but shall limit the selection of components utilized in the design to those listed in the PPSL or those permitted to be used in accordance with approved non-standard parts requests.

As a minimum, passive electronic components shall be selected from Established Reliability (ER) military specifications and shall have an ER failure rate of "P" or better (i.e., R, S or T). Additionally, discrete semiconductors shall be MIL-S-19500 level "JANTX" or better (i.e., JANTXV or JANS) and microcircuits shall be MIL-M-38510 Class "B" or better (i.e., S). Standard electronic modules, in accordance with MIL-STD-1378, shall be used in all new design applications.

*3.1.12.6.2 Configuration Management Program (For Major Projects)

The contractor shall establish a configuration management program incorporating the requirements of attachment (specify - see Appendices D and E for examples). The program shall be documented fully to describe the methods and procedures for configuration identification, control, status accounting and auditing. The configuration management program plan shall be documented as specified in CDRL item number (specify) and shall be submitted for Navy approval.

3.1.13 CONFIGURATION MANAGEMENT AND QUALITY ASSURANCE PROGRAM (COMPUTER SOFTWARE)

Since there is adequate existing authoritative guidance on the subject of computer software configuration management and quality assurance, such information is not repeated in this document. For guidance concerning this subject refer to Section 3.5 of NOSC Technical Note 428, "Product Assurance Requirements for Combat Systems Hardware and Software." Lacking more definitive requirements, the following provides a general quality assurance requirement for computer software.

*Suitable for direct inclusion in a contract Statement of Work

*3.1.13.1 Computer Software Quality Assurance

Computer software quality assurance shall be performed in accordance with MIL-S-52779. A computer software test program shall be implemented in accordance with MIL-STD-1679 (Navy).

3.1.14 INTEGRATED LOGISTIC SUPPORT (ILS) PROGRAM

Aside from the basic operational suitability of equipments/systems to perform their intended function in a reliable and safe manner, there is no greater concern than planned logistic support. When the total logistic support needs of equipments/systems are properly planned and managed, starting early in the development process, optimization of logistic support and economic trade-offs is possible. When this optimization has taken place, then the equipments/systems logistic support requirements are considered to be fully coordinated and integrated.

3.1.14.1 Integrated Logistic Support Program Elements

Integrated Logistic Support (ILS) is a composite of all the support considerations necessary to assure the effective and economical support of systems/equipments throughout their life cycle. It is an integral part of system/equipment acquisition and operation and when it is successful it is characterized by harmony and coherence among all the logistic elements. The principal elements of ILS are:

a. The maintenance planning
b. Manpower and personnel
c. Supply support (including initial provisioning)
d. Support and test equipment
e. Training and training devices
f. Technical data
g. Computer rescurces support
h. Packaging, handling, storage and transportation

ILS is a process which identifies, in a systematic and orderly manner, those functions which must be performed in support of equipment operation and maintenance and the resources required to accomplish them. It also is a combined planning, management and implementation process for obtaining both a supportable item and the required item support. The output documentation of this process is a system Integrated Logistic Support Plan (ILSP) which is the consolidation of all individual logistic support element plans into one interrelated, interfaced and phased program applicable to the system or equipment under development. The ILSP addresses the major support elements of ILS, in detail, as follows:

a. <u>The Maintenance Plan</u>

- The maintenance concept
- Reliability and maintainability data
- Level of repair analysis

---

*Suitable for direct inclusion in a contract Statement of Work

- Maintenance requirements
- Maintenance tasks

b. <u>Manpower and Personnel</u>

- Manpower requirements (numbers of officers and enlisted personnel)
- Personnel skills (classifications) requirements

c. <u>Supply Support Requirements</u>

- Spares
- Repair parts
- Consumables for the maintenance levels at which each replacement part or repair will be accomplished.
- Expected frequency of repair for each repair action

d. <u>Support and Test Equipment Requirements</u>

- Numbers and types of standard test equipment
- Numbers and types of special test equipment
- Tools, etc.

e. <u>Training and Training Devices</u>

- Training requirements (initial and follow-on)
- Training materials
- Training devices or equipment

f. <u>Technical Data</u>

The plan for this element should contain an identification and description of all necessary data (e.g., technical manuals, maintenance requirements cards, drawings) required to operate and maintain the equipment and to procure spares.

g. <u>Computer Resources Support</u>

This plan identifies all computer equipment and computer software requirements and their support requirements.

h. <u>Packaging, Handling, Storage and Transportation</u>

This plan identifies the packaging, handling, storage and transportation requirements and their support requirements.

i. <u>Facilities Requirements</u>

Both shipboard and shore operational and maintenance training facilities should be described in terms of real estate, site improvements or modifications, physical structures and supporting utilities.

While the application of ILS is mandatory (SECNAVINST 5000.39A, "Acquisition and Management of Integrated Logistic Support for Systems/Equipment"), it is not intended that every program be planned to the same level of detail. NAVMATINST 4000.20B, "ILS Planning Policy," indicates that the logistic effort expended for each program should be tailored to meet the specific needs of that program. When ILS planning is initiated early it permits a logical step-by-step process which provides effective support of systems and equipments and ensures timely delivery of required support resources to the fleet, concurrent with system hardware delivery. Additionally, it should be noted that the requirements of the individual SYSCOMs regarding ILS vary.

3.1.14.2 ILS Activities During Various Program Phases

The ILS activities associated with each of the various program phases and the role of the ILS manager during that phase are provided in the following.

3.1.14.2.1 Conceptual Phase

During the conceptual phase the technical, logistic, military and economic bases for an acquisition program are established through comprehensive system studies and experimental hardware development and evaluation. During this phase the integrated logistic support plan (broad in nature) is initiated and special logistic problems to be addressed or studied during this and subsequent phases are identified. In summary, only a broad general plan for ILS is needed; however, any special problems should be noted by the ILS manager.

3.1.14.2.2 Validation Phase

During the validation or advanced development phase the major characteristics (technical, logistic, cost and schedule) are validated through extensive analysis and hardware development. Special logistics problems must be addressed at this time. The role of the ILS manager becomes significant during this phase. Assuming that the validation phase development effort (including the ILS planning) is to be accomplished under contract, the ILS manager establishes the ILS requirements for the contract Request For Proposal (RFP). In connection with the RFP preparation effort, the ILS manager does the following:

a. Develops and defines the system's overall logistic goals for the equipment/system

b. Defines the ILS program requirements clearly and concisely

c. Develops the criteria against which the offeror's proposal will be evaluated, the ranking of the criteria and the quantitative scoring

d. Includes the following if appropriate:

(1) Specific guidance within which the contractor will investigate unique logistic problems, including requirements for specific trade-offs he is to make plus those he is expected to explore

(2) When it is anticipated that the validation phase contractor will likely perform the full-scale development effort as well, each offeror should be required to submit a proposal for follow-on full-scale development/production, to include the following:

(a) A general ILS planning approach, including major milestones, time schedules and, to the extent necessary, a description of how the plan should be executed and monitored during full-scale development/production

(b) An identification of the major integrated logistic support work statements and tasks to be performed during full-scale development/production as the contractor understands them, stated in terms of specific results to be achieved

(c) A network showing the flow and interrelationship of the full-scale development effort planned to implement the ILS requirements

(d) The criteria for the selection and identification of systems and equipments to be analyzed and an estimate of the number of LSA (logistic support analyses) to be performed during the full-scale development phase and the offeror's plan to perform and refine LSAs

(e) The methodology the offeror plans to use to ensure that all logistic costs are reflected accurately in system/equipment life cycle cost estimates

(f) An ILS organization chart, including brief functional statements and the identification of key personnel

(g) A definition of required documentation, communication media and data system (hard copy, microfilm, ADP, etc.) proposed for full-scale development/production

(h) A plan to control the ILS activity of vendors and subcontractors

(i) A plan to support installation and checkout, fitting out and initial fleet operations

(j) An indication of any specific logistic requirements that might be satisfied best by utilizing contractor services for any of the ILS elements, including the type, duration, justification and cost breakdown of any such proposed services

(k) An estimate of the personnel required to accomplish all the ILS effort stated in the RFP during development and production

Following award of the validation phase contract the ILS manager's role becomes one of monitoring the contractor's performance with regard to the ILS program requirements specified in the contract.

3.1.14.2.3 Full-Scale Development Phase

During full-scale development, the equipment/system, including all of the items necessary for its logistic and operational support, is designed and production prototype models are fabricated and tested. The intended outputs of this critical phase are production hardware prototypes, computer software (if applicable), a defined logistic support system and the documentation (i.e., drawings and specifications) needed to produce the item for inventory use and to support (e.g., technical manuals) it in the fleet. At this time the ILS manager's role becomes one of acquiring the support resources required for the equipment/system. The ILS manager's role during the full-scale development phase is as follows:

a. Early in this phase, utilizes the system for planning and acquiring ILS described in Chapter IV of NAVMATINST 4000.20B, implements the ILS plan, including the establishment of formal milestones for various participating government activities

b. If not previously established, organizes and chairs an ILS management team of appropriate government and contractor personnel, specifically including the logistic element managers, to review, guide and approve (as required) contractor actions which must be accomplished during this phase

c. Ensures that the mathematical or simulation models, where utilized for design tradeoff optimization, include a description of the system/equipment configuration as well as their operational modes and determines if the models, through application to alternate designs, are providing alternative performance modes and support approaches

3.1.14.2.4 Production Phase

The production phase begins at the end of the full-scale development phase with the establishment and validation (configuration audits and TECH/OPEVAL successfully completed) of the product baseline. Although actual production may not commence for some time, the establishment of the validated product baseline will mark the beginning of the production phase. The final Integrated Logistic Support Plan should be fully developed by the time actual production begins.

During the production phase the ILS manager should ensure that there is a specific detailed plan for each logistic element that includes provisions for two basic actions: (1) support for the installation and checkout of the individual systems as they are produced and (2) availability of each logistic resource as required to support the operational phase.

The ILS manager should ensure that the plans for all logistic elements are coordinated as an integrated whole for the specific system with specific assignments of responsibility to carry out the entire plan. As a part of this function the manager should ensure that an operational Logistic Support Summary is prepared and provided to Navy user command(s) and supporting organizations for each system, subsystem and equipment requiring significant maintenance. This document should provide, from the operational viewpoint, a brief summary of the item's background, purpose, description, maintenance concept,

planning factors and logistic support elements. It should be a ready reference to more detailed documents needed for timely, adequate logistic support of the item during its operational life. At frequent intervals, the ILS management team should review the overall progress of the contractor and the government in meeting the requirements of the ILS plan. If the ILS planning requirements change, the ILS plan should be updated accordingly.

As appropriate to requirements of the systems command or other sponsor organization, the ILS manager should, early in the phase, develop a transition or turnover plan which indicates when the functional organization will assume responsibility for logistic support of the system/equipment. The plan should include all information necessary for an orderly changeover and continuation of the required logistic support.

3.1.14.2.5 Deployment Phase

The deployment or operational phase begins with delivery of the weapon system/equipment from a production contractor to a Navy user command. At this point equipment/system-oriented logistic support should be available and functioning and providing the capability required for the operational mission.

Following fleet issue, the ILS manager should establish communications with the user command(s) to determine the effectiveness of the initial logistic support provided, for the system/equipment to modify that support as necessary and respond to any need for later modifications to logistic support needs generated by changes to mission profile, hardware, modifications, etc.

The ILS management team should continue to function to the extent necessary to ensure that logistic support changes are developed in an integrated manner. When the logistic support responsibility has been transferred to the designated functional organization, that organization shall assume the responsibilities and perform the functions of the ILS manager.

3.1.14.3 Inclusion of Appropriate ILS Requirements in Contracts

Due to the variation in the SYSCOM requirements and the differences between projects, it is impractical to recommend other than a general set of ILS plan preparation and ILS program support requirements for inclusion in a contract Statement of Work. The following is a recommended contract requirement for a project in the full-scale development phase. It should be understood that the following should be modified or additional ILS program requirements added, as appropriate.

*3.1.14.3.1 Integrated Logistic Support Plan and Supporting Program

The contractor shall prepare an Integrated Logistic Support Plan (ILSP) reflecting the (name) system full-scale development phase. The ILSP shall be documented as specified in the contract data requirements list (CDRL), item

---

*Suitable for direct inclusion in a contract Statement of Work

number (specify) and shall be submitted for Navy approval. Additionally, the contractor shall be responsible for the following:

a. Support and Test Equipment Requirements. Develop a listing of support and test equipment requirements for the operation and maintenance of the (name) system. The contractor shall utilize service approved and standard stock equipments to the maximum extent possible. Unit pricing data for all equipments shall be included in the listing. Full justification for nonservice approved equipments is required. As part of the listing, the contractor shall specify those support and test equipments essential for TECHEVAL/OPEVAL. The list shall be prepared in accordance with CDRL item number (specify) and submitted for Navy approval. Following approval, the service approved and general purpose test equipment necessary for the conduct of fullscale development shall be provided by the government and the nonstandard, special purpose test equipment shall be provided by the contractor.

b. Level-of-Repair Analysis. Perform a level-of-repair analysis (LORA), to the extent necessary, which shall serve as the justification for the decisions made to repair or discard failed parts, modules or assemblies for each anticipated maintenance action at each level of maintenance. Economic considerations shall govern the decision, except where overriding noneconomic criteria can be cited. The results shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

c. Technical Manuals. Develop technical manuals and Maintenance Requirements Cards (MRCs) for use by the (name) system organizational and intermediate maintenance activities. The manuals and MRCs shall address any commercial equipment and GFE which the contractor designs into the system. Their quality and content shall be sufficient to fulfill the requirements imposed by OPEVAL. Following OPEVAL, the manuals and MRCs shall be updated by the contractor to include any necessary changes and shall be prepared in a form suitable for formal fleet manuals publication. The technical manuals shall be prepared in accordance with the technical manual contract requirement (TMCR), Appendix (specify). The manuals and MRCs shall be submitted for Navy approval in accordance with the requirements of CDRL item number (specify).

(Note: Appendix "F" provides an example of a TMCR. While the TMCR is required only by NAVSEASYSCOM, it is considered to be a useful means of describing the requirements for any SYSCOM technical manual.)

d. Maintenance Program. Develop and conduct a maintenance program which will support the (name) system during full-scale development, including TECH/OPEVAL. The contractor shall develop maintenance planning for the full-scale development, production and operational phases of the equipment. The plan shall include decisions derived from logistic support analyses and level-of-repair analyses inputs and shall include the necessary support for the establishment of the planned maintenance system for use in the test and evaluation and in-service phases of the system. The maintenance program plan shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

e. Parts Standardization and Control Program. Establish and conduct a parts standardization and control program for the design and fabrication of

the (name) system. The program shall include the following: the selection of those parts to be incorporated into the design from a Navy approved Program Parts Selection List (PPSL) prepared by the contractor in accordance with MIL-STD-965; use of standard electronic modules in accordance with MIL-STD-1378 in all new-design subsystems, components and equipment in the system; advance approval by the Navy in accordance with Procedure I of MIL-STD-965 of all parts not included in the Navy approved PPSL which are proposed to be used in those subsystems components and equipment which are designed and fabricated by the contractor and subcontractors. The parts standardization program, the PPSL and any requests to use non-PPSL parts shall be documented in accordance with CDRL item numbers (specify) and submitted for Navy approval.

f. Training Requirement. Provide training at (specify where) for Naval personnel in the operation and maintenance of the (name) system. The training is to ensure that naval ship's company personnel from the OPEVAL test ship (or other platform) and other appropriate personnel can operate and maintain the equipment in an operating environment. The course shall be conducted over a continuous period of not less than (specify number) working days and the student body shall not exceed (specify number) and shall include both military and civilian personnel. The skill level of the assigned students will be no less than (specify class) petty officers in sonar, electronic and operations ratings or equivalent. The training shall be planned and conducted in accordance with MIL-STD-1379 and shall include the development of training documentation. Training aids required shall be developed in accordance with MIL-T-81821. The training program plan shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

3.1.15 RELIABILITY/MAINTAINABILITY/AVAILABILITY PROGRAM

The objectives of the reliability/maintainability program are (1) to assure the design of reliable and maintainable systems/equipment and (2) to prevent degradation of the inherent reliability and maintainability of the design during production and throughout operational use.

In the past, reliability requirements included in development contracts often have been limited to numerical requirements statements and to standard tests for their demonstration. Experience has shown that this approach, of itself, is insufficient to assure reliable equipment design since there is an inseparable relationship between material design and reliability. The often stated principal that "quality cannot be inspected into a product - it must be built in" has a close analogy regarding reliability, i.e., "reliability cannot be tested into a product - it must be designed in." Consequently, the emphasis in development should be towards the engineering and manufacturing specifications, disciplines and controls by which reliable and maintainable products are designed and produced, as opposed to total dependence on the specification and measurement of reliability and maintainability levels.

With the goal of ensuring that material reliability is achieved by design and not left to chance, the primary requirements of a reliability program are to:

a. Establish reliability design criteria including quantitative reliability requirements

b. Provide periodic assessments of achieved reliability

c. Identify reliability problem areas in the product design

d. Provide evidence of compliance with requirements

The major elements of a comprehensive reliability and maintainability program are summarized in the following.

3.1.15.1 Reliability Program Elements

3.1.15.1.1 Reliability Modeling

Reliability block diagrams of the product (e.g., system/equipment), down to the major assembly or replacement level, are prepared for each mission phase and are updated as the design evolves. Related mathematical equations are developed to exercise the model to predict, apportion and assess reliability values that will be used to establish design criteria and to support the design analysis. Each block includes the function or item identification, in consonance with the design phase and the current predicted or assessed reliability for the element represented.

3.1.15.1.2 Reliability Prediction

Early in the design phase and continuing to the completion of the design effort, reliability predictions are made in conjunction with the modeling effort. These predictions must be available in sufficient time to have an impact on the design. As a minimum, formal reliability prediction updates should be accomplished for use in conjunction with each scheduled design review. Prediction techniques from MIL-STD-756 and MIL-HDBK-217 and failure rate data from MIL-HDBK-217, GIDEP (Government-Industry Data Exchange Program) data and NPRD-1 (Nonelectronic Parts Reliability Data, available from Rome Air Development Center) can be used. Predicted values also should reflect applicable experience from previous programs.

3.1.15.1.3 Reliability Allocation

Quantitative reliability requirements (mean-time-between-failures) should be allocated to the major assembly or module replacement level, or lower levels as may be required, and should be used as design criteria. Rationale for reliability tradeoffs and other reliability allocation changes should be documented.

3.1.15.1.4 Failure Modes, Effects and Criticality Analysis

Possible modes of failure, their effects on mission objectives, safety and maintenance; their level of criticality; and their relative probability of occurrence should be determined. This failure mode, effect and criticality analysis should be to a level sufficient to reveal significant design deficiencies and potential hazards and to identify critical failure areas. Findings should be used to identify and correct design deficiencies and safety problems to determine need for changes in the test program and to aid in generating technical and operations manuals.

3.1.15.1.5 Reliability Data

A system should be provided for the collection of equipment operating time and cycle data, failures, failure modes and any other pertinent information necessary to support design, reliability analysis and reliability evaluation functions. Provisions should be made to classify failures to ensure adequate and effective use of the data. Classification categories should distinguish relevant and non-relevant failures for reliability evaluation. The system should be included as an integral part of the problem/failure reporting and corrective action system.

3.1.15.1.6 Reliability Measurement

The quantitative reliability of the product (e.g., system/equipment) should be assessed continuously as the development and test program progresses to obtain point estimates and to obtain lower confidence limits of reliability. The assessment process should incorporate and integrate the results of reliability and engineering analyses, valid operating data from previous generations and applicable test data for the quantitative measurement of product reliability. The planned engineering test program should be analyzed to forecast the confidence levels at which reliability requirements may be demonstrated using all test data considered valid to measure product reliability. When this analysis indicates that the normal engineering test program is inadequate to quantitatively demonstrate inherent reliability at the specified confidence level, the following alternatives should be investigated:

a. Additional tests designed for reliability measurement purposes should be proposed for inclusion in the integrated test program. The types of tests and hardware levels at which the tests are to be performed should be optimized for their technical approach and cost effectiveness. Such additional tests and the related "delta" costs should be identified.

b. A product level reliability demonstration test should be designed to demonstrate the specified reliability.

3.1.15.1.7 Reliability Demonstration

A reliability demonstration test plan and procedure to demonstrate the inherent reliability of the product to the specification requirements, should be prepared for one or more milestone models (e.g., full-scale development model). The test plans in MIL-STD-781 or MIL-STD-105 (for one shot devices) or an approved alternative apply. The test plan should include the ground rules and criteria to decide whether a test is classified as a success or failure, or if it is nullified due to invalid data or other factors interfering with the established test conditions (such as range safety or invalid operational procedures). Results of the test should be documented in a reliability demonstration test report.

3.1.15.1.8 **Reliability Reporting**

A reliability status report should be prepared periodically and should include the following:

a. A brief description of the system and equipment operation related to the mission against which reliability is reported

b. Reliability block diagrams and mathematical equations, including assumptions and techniques

c. Data sources and inputs to the model

d. Allocated, predicted and assessed (point estimate and lower confidence limit) reliability values for each mission phase

e. Growth curves related to the model for the system and equipments showing estimated reliability-versus-time and showing the required reliability

f. Failure rate estimates (point and confidence limit), number of failures, operating time and cycles for the current configuration

g. Summary of problems with their proposed corrective action and a discussion of significant events and achievements

h. Results of operational availability evaluation (see Paragraph 3.1.15.5.3)

3.1.15.1.9 **Components Selection, Utilization and Control**

The proper selection and utilization of components are crucial to the task of ensuring that reliability is designed into equipment and is not left to chance.

While standard military quality specifications (e.g., MIL-E-16400) provide general assurance that equipment can withstand the environmental extremes and other rigors of service use, these specifications alone do not assure low equipment failure rates. In addition to requiring these general specifications the equipment designer also should consider these important component related factors:

a. <u>Component Quality</u>. In the field of electronics, controls have been established which allow the specification of components having a predictable failure rate. Reliability screening levels (also referred to as quality or product assurance levels) are specified for three categories of military electronic components:

(1) Screened military grade <u>active and passive electrical parts</u> (e.g., relays, coils, connectors, resistors and capacitors) are procurable to Established Reliability (ER) military specifications and are categorized as to ER failure rate levels L through T, with T being the highest quality. Parts with ER failure rates of "P" or better (i.e., R, S or T) should be used in the design of Navy electronic equipment.

(2) Screened military grade discrete semiconductor devices (transistors, diodes) are procurable to MIL-S-19500 and its detailed slash sheets and are categorized as JAN, JANTX, JANTXV and JANS, with JANS being the highest quality. JANTX or better (i.e., JANTXV or JANS) discrete semiconductor devices should be used in the design of Navy electronic equipment. JANTX parts, in addition to the JAN military standardization processing requirements, undergo specific process and power conditioning tests to enable defective parts to be eliminated. The TX suffix to JAN designates this "Testing Extra." JANTXV devices require all the testing performed on JANTX parts plus an internal visual inspection, performed before hermetical sealing, which further eliminates defective units. JANS components undergo further testing and controls.

(3) Screened military grade microcircuits are procurable to MIL-M-38510 and are categorized as to screening Class S, B or C, with S being the highest quality and C the lowest. Class B or S quality microcircuits should be used in the design of Navy electronic equipment. Microcircuits procured to MIL-M-38510 have a JAN designation and undergo Class S, B or C screening tests in accordance with Method 5004 (monolithic) or Method 5008 (hybrid) of MIL-STD-883. Additionally, MIL-M-38510 device manufacturers must undergo extensive certification requirements and sample qualifications.

Where MIL-M-38510 microcircuits are not available, commercial parts may be utilized providing they have been screened to the MIL-STD-883 Class B or S requirements. It must be recognized, though, that commercial components generally have not had the same in-process controls as MIL-M-38510 parts and, even with MIL-STD-883 screening, generally will exhibit higher failure rates than their MIL-M-38510 counterparts.

Appendix M (Description of Quality/Reliability Screening Levels of Standard Parts) provides additional information concerning this subject, including providing relative failure rates. MIL-HDBK-217 contains failure rate data for specific components.

b. Component Derating. "Derating" refers to the application of components in equipment design so that the actual stresses (failure forcing functions) are substantially less than the component design maximum ratings. Design maximum ratings refer to the maximum capability of a part as established by the manufacturer. Derating, therefore, is the reduction of the impact of various kinds of stresses on a part to decrease the degradation rate and prolong the expected life of a part. It also allows added protection from system anomalies unforeseen by the designer, such as combined transient stresses. Derating is a well-known and commonly practiced procedure and one of the most powerful reliability tools available to the equipment designer.

Derating of electronic parts is analogous to the use of safety factors in structural design.

A part's strength or ability to handle a given stress varies from lot to lot and manufacturer to manufacturer. This variation for all parts of the same type can be represented by a statistical distribution of part strength. Similarly, the stress applied to a part changes from one point in time to another with instantaneous changes in temperature, electrical stresses and transients, vibration, shock and other deleterious environments. At a random

point in time, the environmental effects can combine to reach stress levels beyond the part's strength and result in failure of the part. These failures are termed random failures and the rate at which they occur are the published random failure rates provided by MIL-HDBK-217.

To reduce the probability of part failure or the part's "random" failure rate, one of two approaches must be taken: reduce the potential stress levels to a point where there is a very small probability of the stress exceeding the part's strength or increase the part's strength so there is very little probability of the combined stresses reaching or exceeding this strength. In most instances the stresses cannot be reduced and the only approach is to increase the part's strength. This is accomplished by using a larger or stronger part stressed to only a percentage of its capability. In other words, using high factors of safety. This is known as part derating.

Besides reducing part random failure, derating of parts reduces part internal operating temperatures, decreasing the rate of chemical time-temperature reaction which is the primary cause of part aging and parameter drift.

Different part types are failure sensitive to different kinds of environmental and electrical stresses such as temperature, power, voltage, current, humidity, shock, vibration, altitude, acceleration, etc. These are the stresses for which a particular part must be derated. A listing of the electrical stresses and the recommended maximum percentage (derating) of rated stresses for high reliability application are provided in Table 1 of NAVSEA 0967-LP-597-1001.

c. Variability Analysis. All electronic components and devices are manufactured to have their important parameters lie between two extreme values called tolerance limits. Tolerance limits include initial tolerances and drift due to age and environments. The parameters may vary and have any value between these two limits. Variability analysis is a technique by which one can determine, to a very good approximation, whether a system consisting of these parts will work within the specification limits, when the part parameters vary between their limits.

There are five primary methods of circuit variability analysis: the Worst-Case, the Parameter Variation, the Moment, the Monte-Carlo and the Empirical method. A detailed description of these analytical methods is provided in NAVSEA 0967-LD-597-1011.

d. Component Control. An important step in controlling the selection of components for electronic equipment design is the establishment of a parts control program and the generation of a Program Parts Selection List (PPSL) which meet the requirements of MIL-STD-965. The purpose of the program and the PPSL is to ensure that the contractor will select, whenever possible, standard military parts of the perferred type and quality. Where standard parts are not available and nonstandard parts must be utilized, the MIL-STD-965 parts control program will require the contractor, through the use of nonstandard parts requests, to obtain Navy approval of all such deviations. In such cases, the Navy can ensure that adequate qualification and reliability screening tests are applied to such parts.

Parts selection and control are extremely important development program activities which can be costly. These activities also can be a significant administrative burden. Because of the sheer volume of parts decisions in large programs and the time and cost pressures involved, the tendency is to cut corners, to simplify the procedures or to drift towards a "rubber-stamp" type operation. These tendencies must be resisted. The impact of reliable components on life cycle cost, system effectiveness and logistic supportability is great. A good parts program can be expensive but the costs of system failures, redesign and ORDALT programs can make it inexpensive by comparison. Paragraph 3.3.1.4 provides additional information concerning component selection and control programs.

e. Cost of Preferred Quality Components Versus Equipment Reliability. One source has estimated that the components (commercial grade) in production military electronic equipment typically represent 25 percent of the equipment cost. When the same equipment utilizes preferred quality military components (ER level P active and passive electrical components, JANTX semiconductors and Level B MIL-M-38510 microcircuits) it is estimated that the parts cost is increased 100 percent and the equipment cost is increased 25 percent. However, as a result of using the preferred quality parts, the equipment mean-time-between-failures (MTBF) would be expected to be 14 to 20 times higher than the same equipment using commercial components.

3.1.15.1.10 Reliability Program Review

During the formal project design reviews (Paragraph 3.3.1.7) which are required by NAVMATINST 3000.1A and by NOSCINST 4855.1, the reliability program efforts leading to the various design decisions are reviewed. This normally would include a review of the requirements, modeling, predictions, apportionment, failure modes and effects analysis, parts selection and the overall design for reliability, as well as for other characteristics. Because of the volume of these efforts, this reliability program review is expected to be accomplished during the formal design review at a summary level of detail. Consequently, it is recommended that advance, informal detail design reviews be conducted between the designers and the reliability and system safety engineers. With such advance reviews, the formal design reviews should run smoothly and should result in a readily available summary of key decisions and supporting rationale. (Also see Section 3.3.1.7.)

In the proper project environment, the designer views the reliability and the other product assurance engineers as partners in meeting project goals, rather than as critics. However, this environment can be established only when the reliability and other product assurance requirements are viewed as essential design parameters along with the performance requirements.

3.1.15.2 Maintainability Program Elements

3.1.15.2.1 Maintainability Modeling

Maintainability block diagrams of the product (e.g., system/equipment) down to the shipboard maintenance indenture level (i.e., module replacement level) should be prepared and updated as the design evolves. The mode should designate the levels at which shipboard repair is to be accomplished

and where fault localization is to be extended. Related mathematical equations should be developed to exercise the model to predict, apportion and estimate maintainability values that will be used to establish design criteria. Each block should include item identification in consonance with the design phase, the current predicted or estimated maintainability and the apportioned maintainability goal for the element represented. The modeling effort should be accomplished in conjunction with the maintainability analysis (see Paragraph 3.1.15.2.4).

3.1.15.2.2 Maintainability Prediction

Starting early in the design phase and continuing to the completion of the design effort, maintainability predictions (i.e., mean-time-to-repair, mean-time-to-restore) should be made in conjunction with the modeling effort. These predictions must be available in sufficient time to have an impact on the design. Prediction techniques and data from MIL-HDBK-472 and from GIDEP (Government-Industry Data Exchange Program) can be used. Predicted values should reflect applicable experience in previous programs. The prediction effort should be accomplished in conjunction with the maintainability analysis (see Paragraph 3.1.15.2.4).

3.1.15.2.3 Maintainability Allocation

Quantitative maintainability requirements (mean-time-to-repair, mean-time-to-restore) should be allocated to product elements down to the lowest shipboard maintenance indenture level (i.e., module replacement level) and used as design criteria when maintainability predictions indicate that the maintainability requirements may not be met. The allocation effort should be accomplished in conjunction with the maintainability analysis (see Paragraph 3.1.15.2.4).

3.1.15.2.4 Maintainability Analysis

The maintainability analysis is a process which translates the inputs obtained through studies and from Navy operating constraints into detailed qualitative and quantitative (i.e., mean-time-to-repair) maintainability requirements and into the detailed maintenance plan. These inputs include: operational and support concepts and requirements, including environmental conditions; overall quantitative maintainability requirements; personnel subsystem constraints; projected facility, training program, skills, equipment and tool availability; cost constraints; studies and engineering reports for the system/equipment concerned; and lists of standard tools and equipment.

The maintainability analysis is required to enable the accomplishment of other program tasks including the modeling, prediction and allocation tasks. The analysis considers the various design trade-off options available which, when selected, are translated into qualitative and quantitative design criteria expressed in the system/equipment development specifications. During the demonstration evaluation period the maintainability analysis data are used to determine the degree of achievement of the maintainability design requirements. The maintainability analysis is updated as various system/equipment maintainability data become available.

3.1.15.2.5 Maintainability Data

A system should be provided to collect repair time, total down-time, repair frequency and other pertinent maintainability data necessary to support the design, maintainability analysis updating and maintainability evaluation functions. These data also should serve as inputs to maintenance planning. The system should be included as an integral part of the problem/failure reporting and corrective action system described in Paragraph 3.1.8.

3.1.15.2.6 Maintainability Measurement

The quantitative maintainability of the product and its elements should be continuously assessed as the design and test program progresses. The evaluation process should incorporate and integrate the results of the maintainability data analysis and all applicable test data. The integrated test program plan should provide for maintainability tests which verify maintenance procedures and quantitative and qualitative maintainability requirements. Point estimate and the upper confidence limit of achieved maintainability should be provided for quantitative requirements.

3.1.15.2.7 Maintainability Demonstration

A plan for demonstration of the maintainability requirements should be prepared. The approach and the details of demonstration should be described in a maintainability demonstration plan which should be prepared in accordance with MIL-STD-471. Upon completion of the demonstration, a maintainability demonstration report should be prepared detailing results of the demonstration.

3.1.15.2.8 Maintainability Reporting

A maintainability status report should be prepared periodically which should include:

a. A brief description of the system or equipment operation related to the mission against which maintainability is reported

b. Apportioned, predicted and assessed (point estimate and upper confidence limit) maintainability values in quantitative and qualitative terms, as appropriate

c. Data sources and impact of failures on maintainability predictions and assessments

d. Summary of problems with their proposed corrective action

3.1.15.3 Availability Program Objective

Availability is the probability that an item of equipment will be capable of performing its specified function when called upon at any random point in time. The inherent availability (A_i) of an item is a function of its mean-time-between-failures (MTBF) and its mean-time-to-repair (MTTR). The operational availability (A_o) of an item includes the additional consideration of

supportability (see Paragraph 1.4 - Definitions). To assist in making reliability-maintainability-supportability trade-off decisions, an availability program is established which recognizes this relationship and provides a measure of achievement. This program should be integrated and conducted in conjunction with the reliability and maintainability evaluation and, when conducted by a contractor, should be reported as part of the reliability program status report.

NAVMATINST 3000.2 "Operational Availability of Weapon Systems and Equipments" establishes the operational availability (A_o) as the primary measurement of material readiness for Navy weapons systems and equipment. NAVMATINST 3000.2 also provides policy relative to the operational availability objectives and provides methods for calculation.

3.1.15.4 Reliability/Maintainability Activities During Various Program Phases

Planning consists of identifying desired goals and then establishing the best course of action to achieve those goals. R&M planning is not necessarily a separate activity, but is an effort which must be integrated into the overall planning for the system. In the conceptual phase, for example, the choice of system design alternatives must include their potential reliability and maintainability and attendant support costs in order to select the most cost-effective system alternative. In later development stages, R&M estimates are needed as inputs for system support planning for spare parts, depot facilities, training, etc. Hence, R&M is a key element in overall program planning and from this planning should emerge a set of realistic R&M objectives.

From the R&M planning viewpoint, the selection of a reliability/maintainability conscious development contractor is crucial to the success of the project, particularly with regard to full-scale development. Typically, the selection of such a contractor is a difficult and time consuming task, particularly with the larger, more complex systems where the contractors' proposals, submitted in response to the RFP, can comprise several hundred pages. The task in proposal evaluation is to consider the particular aspects, in this case R&M, of each proposal to ensure that the bidder understands what is required of him and is both willing and able to meet those requirements.

The proposal is the first opportunity where a prospective contractor may seek to obtain relaxation of the R&M requirements, often through the very subtle use of words and R&M jargon which, to the non-specialist, seem to promise more than they actually do. Knowing the man-loading (not cost) that the contractor proposes to apply to the R&M activities provides insight as to how seriously that contractor views the requirements. This information can be provided to the technical reviewer if the requirement is expressed to the contracting office in advance. Under the working pressure of source selection, even the experienced R&M engineer must guard against a tendency to assume too much. Questions, to clarify proposals and later negotiations with bidders in the competitive range, must resolve any uncertainty and ensure the contractor indeed is proposing the R&M program that the Navy desires. Careful consideration of R&M during proposal evaluation and during subsequent negotiations prevents the contractor from forming the erroneous conclusion that R&M need not

be of great concern during the program and will reduce the potential for disputes later on.

The best method for putting emphasis on R&M early in the program is to require each bidder to submit a preliminary R&M program plan with his proposal for evaluation by the source evaluation team. Deficiencies in the preliminary R&M program plan then will be the subject of precontract negotiations and these deficiencies can be ironed out before a contract is signed. If properly written, the negotiated R&M program plan then can be incorporated into the contract and become the basis for contractual compliance. This precontractual approach to the R&M program plan will ensure that the R&M program gets off to a good start, with the government and the contractor having a mutual understanding of the R&M program elements and the ground rules for their accomplishment.

In the R&M program plan, the contractor defines his approach to achieving R&M requirements, his milestones and his organization. This plan is very important since it establishes the understanding between the contractor and the Navy on the R&M effort expected and provides a reference for review and control. Hence, this document must reflect the Statement of Work requirements and completely describe an adequate program to pursue them. The approved R&M program plan (preferably negotiated before contract signing) should leave no doubts about what will be accomplished.

3.1.14.5.1 Conceptual Phase

During the conceptual phase, the primary reliability/maintainability objective is to review the system operational requirements to establish reliability and maintainability goals. Plans are developed during this phase primarily to assure that the reliability and maintainability goals are compatible with the system design concept. Where the equipment design concept is well defined, predictions are made based on historical equipment level experience data. These first estimates will begin the R&M planning activity, but the estimates must be modified repeatedly and refined as more data become available in later phases.

After preliminary system tradeoffs are made and preliminary R&M objectives are set, the next task is to prepare the overall program management plan.

The program management plan (PMP) is the master plan for the achievement of the overall program objectives. While most R&M activities will not occur until later, R&M planning in the PMP document should provide for:

a. Definition and refinement of realistic quantitative R&M requirements to be finally demonstrated in the full-scale development tests

b. Parts selection using military standard parts to the maximum extent possible

c. Tracking R&M progress throughout the program to provide a continual measure of achieved, versus required, R&M

d. A planned period of R&M growth during validation and full-scale development, using all available failure and maintenance data for R&M problem analysis and correction during this period

e. Program review milestones for assessment of R&M progress (these may, of course, be merged with other review milestones as appropriate)

f. Adequate personnel to ensure competent R&M planning and surveillance of the contractor's efforts and the possible need to use outside agencies for R&M support

g. Interface with the eventual using and support commands on R&M requirements and plans

R&M efforts during the latter portion of the conceptual phase include the preparation of the system development specification, the request for proposal (RFP) for the validation phase and the preparation of contractor proposal evaluation criteria. Tables 3.2a and 3.3 provide a graphic description of the impact of reliability/maintainability during the conceptual phase. Table 3.2b identifies those reliability tasks typically included in an effective reliability program.

3.1.15.4.2 Validation Phase

During the validation or advanced development phase, the reliability/maintainability requirements become increasingly more specific and comprehensive. Establis ing these requirements should be a rational process that develops a balance between needs and what is achievable based on actual fleet experience and the state of the technology.

Hardware will be developed and tested during the validation phase and R&M planning will focus on the contractual requirements. The following items should be included in the contract Statement of Work for the validation phase effort:

a. Quantitative R&M requirements should be specified and defined although it is recognized that these requirements might not have to be achieved by the actual experimental hardware developed and tested in the validation phase. However, the basic hardware design must be capable of achieving the required R&M and the R&M predictions should substantiate this.

b. Testing of validation model units is essential to verify the likelihood of achieving the R&M goals during the final full-scale development phase. This verification may be achieved in connection with evaluation testing or demonstration testing or both. The extent of the R&M test program, its intent and, if applicable, the acceptance criteria should be clearly established.

c. Parts selection must be controlled. However, because of difficulties in obtaining preferred quality parts in small quantities, it may not be practical to fully employ them in the validation phase hardware. Any substitute parts must be identical in form, fit and function to the preferred parts.

Program Element	Equipment Life Cycle Phase: Conceptual	Validation (Advanced Development)	Full Scale Development	Production	Deployment
Requirements definition	XXXXXXXXXXXX	XXXXXXAAAAAAA	A		
Reliability modeling	XXXXXXX	XXXXXXXXXXXXX	XXXX		
Reliability prediction	XXXXXXX	XXXXXXXXXXXXX	XXXX		
Reliability apportionment	OOOOOOO	OOOOOOOOOOOOO	OOOO		
Failure mode, effect and criticality analysis (FMECA)	OOOOOOO	OOOOOOOOOOOOX	XXXX		
Design for reliability	OOOOOOO	XXXXXXXXXXXXX	XXXXXXXXXXXX . .	. . . .	
Parts selection	OOOOOOO	XXXXXXXXXXXXA	AAAA	. . . .	
Design review	OOOOOOO	XXXXXXXXXXXXX	XXXX		
Design specifications	XXXXXXXXXX	XXXXXXXXXXXXX	X		
Acceptance specifications	XXXXX	XXXXXXAAAAAAA	. . . .		
Reliability measurement	- - - - - -	XXXXXXXXXXXXX	XXXXXXXXXXOOO	OOOOOOOOOOOO	OOOOOOOOOOOO
Failure analysis	- - - - -	XXXXXXXXXXXXX	XXXXXXXXXXOOO	OOOOOOOOOOOO	OOOOOOOOOOOO
Reliability data system	- - - - -	XXXXXXXXXXXXX	XXXXXXXXXXOOO	OOOOOOOOOOOO	OOOOOOOOOOOO
Quality assurance		OOOOOOOOOOOOX	XXXXXXXXXXXXXX	XXXXXXXXXXXX	OOOOOOOOOOOO
Environmental tests		XXXX .	. . . . AAAAAA	. . . .	
Reliability demonstration		XX .	. . . . AAAA	OOOOOOOOOO	

First contract

KEY

- - - - - Desirable activity (for highest success probability)
OOOOO Necessary activity (errors seldom disastrous)
XXXXX Very important activity (errors often disastrous)
AAAAA Critical activity (errors usually disastrous)
. . . . . Low key acitivity (to update previous results)

Table 3.2.a. The importance of the reliability program as a function of the life cycle phase of the equipment.

Task *	Title	Task Type	Program Phase			
			Concept	Valid	FSD	Prod
101	Reliability program plan	MGT	S	S	G	G
102	Monitor/control of subcontractors and suppliers	MGT	S	S	G	G
103	Program reviews	MGT	S	S(2)	G(2)	G(2)
104	Failure reporting, analysis, and corrective action system (FRACAS)	ENG	NA	S	G	G
105	Failure review board (FRB)	MGT	NA	S(2)	G	G
201	Reliability modeling	ENG	S	S(2)	G(2)	GC(2)
202	Reliability allocations	ACC	S	G	G	GC
203	Reliability predictions	ACC	S	S(2)	G(2)	GC(2)
204	Failure modes, effects, and criticality analysis (FMECA)	ENG	S	S (1)(2)	G (1)(2)	GC (1)(2)
205	Sneak circuit analysis (SCA)	ENG	NA	NA	G(1)	GC(1)
206	Electronic parts/circuits tolerance analysis	ENG	NA	NA	G	GC
207	Parts program	ENG	S	S(2)	G(2)	G(2)
208	Reliability critical items	MGT	S(1)	S(1)	G	G
209	Effects of functional testing, storage, handling, packaging, transportation, and maintenance	ENG	NA	S(1)	G	GC
301	Environmental stress screening (ESS)	ENG	NA	S	G	G
302	Reliability development/growth testing	ENG	NA	S(2)	G(2)	NA
303	Reliability qualification test (RQT) program	ACC	NA	S(2)	G(2)	G(2)
304	Production reliability acceptance acceptance test (PRAT) program	ACC	NA	NA	S	G(2)

Code Definitions

Task Type

ACC - Reliability accounting

ENG - Reliability engineering

MGT - Management

*(MIL-STD-785B)

Program Phase

S - Selectively applicable

G - Generally applicable

GC - Generally applicable to design changes only

NA - Not applicable

(1) - Requires considerable interpretation of intent to be cost effective

(2) - MIL-STD-785 is not the primary implementation requirement. Other MIL-STDS or Statement of Work requirements must be included to define the requirements.

Table 3.2.b. Identification of those tasks (MIL-STD-785B) typically included in an effective reliability program.

Program Element	Equipment Life Cycle Phase				
	Conceptual	Validation (Advanced Development)	Full Scale Development	Production	Deployment
Requirements definition	XXXXXXXXXX	XXXXXXXXXXXAAA	AAA		
Maintenance concept	XXXXXXXXXX	XXXXXXXXXXXXX	XXXXXX		
Maintainability Analysis	XXXX	XXXXXXXXXXXXX	XXXXXX		
Design for maintainability	OOOOO	OOXXXXXXXXXXX	XXXXXXXXXXXXX	. . . .	
Maintainability modeling, prediction and apportionment	OOOOO	OOXXXXXXXXXXX	XXXXXX		
Design review	OOOOO	OOXXXXXXXXXXX	XXXXXX		
Design specifications	XXXXXXXX	XXXXXXXXXXXXX	XXXX		
Acceptance specifications	XXX	XXXXXXXXXXXAAA	AAA		
Detailed maintenance plan	OOOOO	OOOOOOOOOOOOO	OXXXXXXXXXAAAA	. . . .	. . . .
Maintainability measurement		XXXXXXXXXXX	XXXXXXXXXXXXO	OOOOOOOOOOOO	OOOOOOOOOOOO
Maintainability data		XXXXXXXXXXX	XXXXXXXXXXXXO	OOOOOOOOOOOO	OOOOOOOOOOOO
Technical manuals		OOOOOOOOOOO	OXXXXXXXXXXAAA	. . . .	. . . .
Maintainability demonstration		X	X . . . . AAA	. . . .	

First contract

KEY

- - - - - Desirable activity (for highest success probability)
OOOOO Necessary activity (errors seldom disastrous)
XXXXX Very important activity (errors often disastrous)
AAAAA Critical activity (errors usually disastrous)
. . . . . Low key activity (to update previous results)

Table 3.3. The importance of the maintainability program as a function of the life cycle phase of the equipment.

d. Fundamental design features which will affect maintainability must be evaluated. For example, to the extent practical, built-in test provisions should be included in the validation phase equipment to permit evaluation of its functional effectiveness, even though the exact physical makeup of the hardware may not correspond to operational standards.

e. R&M design tradeoff studies should be performed. These include design for reliability, design for maintainability, redundancy options, optimum repair level analysis, failure mode analysis and any others required to optimize the design or to provide input for other plans such as the detailed maintenance plan or ILS plan.

f. R&M predictions should be refined continually as the design progresses to provide an indication of potential R&M for use in making a full-scale development decision.

g. A closed loop data system is required for obtaining R&M data from all tests performed. These data then should be used to determine the cause of R&M problems and formulate corrective action.

h. Program and design reviews are essential for control and motivation of the entire R&M program and to ensure that the detailed R&M design effort is progressing satisfactorily.

i. Appropriate deliverable data items should be selected to give the project office needed visibility into the contractor's R&M activities and to document results.

By the end of the validation phase, the project office should have received the following <u>R&M products required to make decisions and plans for the full-scale development phase</u>:

a. Predictions of the potential R&M of the system should be up-to-date. These should be derived realistically and should be commensurate with the expected operational environment and the selected parts quality. A historical record of these predictions should have been continuously updated through the validation phase.

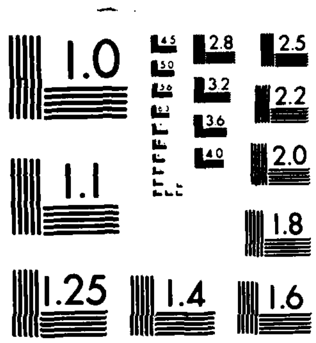
b. Achieved R&M of the validation hardware based on actual test data should be in hand. Most of the time, the achieved R&M will be significantly below the predicted and required values. Hence, the project manager must have evidence of R&M growth experienced during this phase and must be able to show sound engineering solutions to all R&M problems. As far as possible, these solutions should be tested and validated during the validation phase.

c. System design tradeoff studies should be complete, using realistic R&M inputs, to define the most cost-effective system configuration.

d. System design specifications intended for the full-scale development phase are needed. These must incorporate clearly defined quantitative R&M requirements and all the corresponding R&M design requirements necessary for their achievement, that is, parts selection criteria, built-in test features, modular configuration, environmental criteria, etc.

AD-A126 678 PRODUCT ASSURANCE REQUIREMENTS GUIDE FOR NAVAL OCEAN SYSTEMS CENTER PROJECTS(U) NAVAL OCEAN SYSTEMS CENTER SAN DIEGO CA 21 DEC 82 NOSC/TD-432 2/5

UNCLASSIFIED F/G 5/1 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

e. System acceptance specifications are needed which define R&M demonstration tests to be performed in the full-scale development and production phases, including the test levels, system burn-in requirements, ground rules for test measurements, ground rules for classification of fai ıres and so on. Environmental qualification tests also must be defined.

f. Ideally, the R&M program plan for full-scale development should be completed by the end of the validation phase. This plan can then be included in the full-scale development contract as a requirement.

g. The project manager must prepare a Navy R&M management plan. This will be included as part of the program management plan (PMP) prepared earlier.

It can be expected that approval to proceed to full-scale development will be based on assurance that system tradeoffs have produced a balanced and realistic set of performance parameters, risk areas have been identified and reduced to acceptable levels, cost and schedule estimates for full-scale development are reasonable and acceptable and anticipated contractual aspects are sound.

In summary, it can be seen that during the validation phase the conceptual design is transferred into practical design criteria suitable for full-scale hardware development. Simply stated, from NAVMAT's viewpoint there are two major reliability goals to be achieved during the validation phase:

a. A mission profile must be established to define the boundaries of the performance envelope, provide the timeline (environmental conditions and applied/induced stresses versus time) typical of operations within that envelope and, where appropriate, identify all constraints.

b. Based on gained experience a quantitative reliability requirement must be established for the defined mission profile in terms of a mean-time-between-failures (MTBF) (probabilistic requirements should be used only for material for which operating time is undefinable, such as explosives).

Beyond the achievement of these goals, the project manager, assisted by the R&M engineer, must prepare the equipment development specification, the RFP for the full-scale development phase and the preparation of the contractor proposal evaluation criteria.

Tables 3.2a and 3.3 provide a graphic description of the impact of reliability/maintainability during the validation phase. Table 3.2b identifies those reliability tasks typically included in an effective reliability program.

3.1.15.4.3 Full-Scale Development Phase

From an R&M viewpoint, the essential difference between the validation phase and the full-scale development phase is that during the validation phase the realism of the R&M requirements must be verified, major system design trade-offs must be made and major R&M problems must be identified and eliminated. During full-scale development, however, the requirements are firm and

the program is geared toward implementing final design decisions and proving through demonstration tests that R&M requirements will be met.

Thus, during full-scale development the reliability and maintainability requirements remain fixed and the reliability and maintainability programs become fully mature. The major reliability and maintainability goals at the completion of this phase are to provide an accurate and comprehensive statement of achievement as it relates to the requirements. When the requirements are not achieved, the justification for the shortcomings and plans to correct these shortcomings are presented for consideration to and approval of the cognizant systems command. The reliability/maintainability effort during this phase consists of upgrading the reliability/maintainability plans for consonance with the major activity of the phase: to transform the validation phase design into a producible design for production. During this phase the activity will focus on preparing for TECHEVAL/OPEVAL and obtaining approval for service use (ASU). Reliability/maintainability tasks will include:

a. Preparation of detailed and accurate predictions and allocations (see Paragraphs 3.1.15.1.2 and 3 and 3.1.15.2.2 and 3)

b. Performance of failure modes, effect and criticality analyses (see Paragraph 3.1.15.1.4)

c. Performance of maintenance engineering analyses (see Paragraph 3.1.15.2.4)

d. Establishment of demonstration plans and procedures (see Paragraphs 3.1.15.1.7 and 3.1.15.2.7)

e. Evaluation of proposed components in connection with a formal parts and materials selection program (see Paragraphs 3.1.15.1.9 and 3.5.1.4)

Where the development effort is being conducted under contract, as often is the case, the government's role becomes one of monitoring the contractor's R&M planning and analyses efforts. This includes:

a. Review of the contractor's predictions, allocations and failure modes, effects and criticality analyses

b. Participation in design reviews

c. Review of requests for the use of nonstandard parts

d. Review of proposed development specification changes

e. Review of product specifications

f. Participation in the development of the spares requirements

g. Review of equipment failure analyses and corrective action reports

h. Review of the R&M test plans and procedures

The R&M test plans and procedures provide the details of the R&M demonstration tests. While general ground rules are covered by the contractual documents, the plan covers the multitude of requirements which must be defined before the tests are run. It is a potential source of compromise to the intent of the test requirements and careful review is essential. While the main thrust of the R&M effort should be directed towards obtaining unambiguous requirements, conservative design and the selection of quality parts, the R&M demonstration tests are essential.

During TECH/OPEVAL the R&M effort includes the analysis or the review of the analysis of failures encountered during these evaluations. Analysis of the results of the various demonstration tests and correlation of these results with the requirements are included in the final stages of the phase. A final task is the development of the reliability program requirements for production.

Tables 3.2a and 3.3 provide a graphic description of the impact of reliability/maintainability during the full-scale development phase. Table 3.2b identifies those reliability tasks typically included in an effective reliability program.

Guidance is provided in Paragraph 3.1.15.4 regarding those provisions to be made in the RFP solicitation to facilitate selecting a competent full-scale development phase contractor, from the R&M viewpoint.

3.1.15.4.4 Production Phase

During production the R&M effort must ensure that the design is faithfully produced for service use as documented and validated during development. The effort includes close monitoring of the production contractor's piece-part test results, preproduction sample test results and factory and final acceptance test results. During this period close attention is paid to the contractor's failure analyses and his requests for engineering changes. During production, the technical direction agent, often NOSC, must ensure that the reliability and maintainability inherent in the equipment design are not compromised by the approval of nonessential deviations and waivers or by poor quality manufacture.

Tables 3.2a and 3.3 provide a graphic description of the impact of reliability/maintainability during the production phase. Table 3.2b identifies those reliability tasks typically included in an effective reliability program.

3.1.15.4.5 Deployment Phase

During the initial portion of the deployment or operational phase, the principal R&M concern is the integration of the system with its logistic support (i.e., support and test equipment, spare parts, special packaging and transportation, technical manuals and operation and maintenance personnel). Particular attention should be paid to the technical manuals and their use by the fleet personnel. The technical manuals must be used faithfully in connection with equipment operation and maintenance to preserve the inherent design reliability and maintainability and to ensure a continuing fleet capability.

Later in this phase, as the initial provisioning or spare parts are exhausted, attention must be given to ensure that high quality replacement parts are provided. Poor quality replacement parts must not be permitted to dilute the equipment reliability.

A failure reporting, collection and analysis program, often called a reliability data bank, is essential to maintain the fleet equipment invertory in a high state of readiness. All organizational (user) level and intermediate level failures should be reported and those data, together with any depot data regarding the analysis and repair of the failed equipment, should be accumulated in a form that can be accessed easily. This data program, in addition to having readily accessible information, should have a "failure alert" feature which automatically highlights equipment/subassembly/component failures that reach a preestablished threshold. Typically, reliability tasks during this phase consist primarily of monitoring the reliability of the stockpile through several means:

a. Monitoring fleet failure reports and the reliability data bank outputs

b. Visiting organizational units that use the equipment and observe operational and maintenance operations

c. Reviewing fleet exercise and operational reports

d. Visiting depot activities responsible for equipment maintenance

Most failure data reporting systems, unfortunately, are weak; while they provide basic failure data, they do not provide total equipment "on-time" data which are necessary if the true reliability (mean-time-between failures) of the equipment is to be determined. Additionally, few systems provide the detailed analysis of the failure cause. The cause of failure should be traced to the component responsible and the failure mechanism within the component should be identified wherever possible. As a result of the fleet deployment phase experience, reliability or maintainability improvement programs may be required and will require the specialist's continuing involvement. Additionally, particularly where there is to be continuing or follow-on production of additional units, there will be the on-going tasks to review proposed engineering changes submitted by contractors and proposed maintenance procedure changes submitted by fleet or depot activities. Tables 3.2 and 3.3 provide a graphic description of the impact of reliablity/maintainability during this phase.

3.1.15.5 Inclusion of Appropriate R/M Requirements in Contracts

The requirements for reliability and maintainability programs will vary depending on the nature of the equipment and the phase of acquisition. The following are suggested contract requirements, of a general nature, for a project in the full-scale development phase.

*3.1.15.5.1 Reliability Program

The contractor shall establish and maintain a reliablity program meeting the requirements of MIL-STD-785. The program objective shall be to assure that the numerical reliability requirements established in the system development specification (title, number, date) are attained. The reliability program plan shall be documented as specified in contract data requirements list (CDRL) item number (specify) and shall be submitted for Navy approval. The plan requires approval by (activity name, code) prior to implementation. In conducting the reliability program, the contractor shall:

a. Allocate or apportion the specified numerical reliability requirements to the major subsystem elements (name the elements) and document such allocation in accordance with CDRL item number (specify). Reliability predictions shall be performed in accordance with MIL-STD-756 (specify type). MIL-HDBK-217 shall be used as the basic data source. The predictions (and the design) shall be based on a detailed thermal/electrical/mechanical stress analysis of each part and shall reflect the part derating policy of NAVSEA document 0967-LP-597-1011. The results shall be documented in accordance with CDRL item number (specify) and submitted for Navy approval. The initial prediction is to be provided 60 days prior to the critical design review (CDR) with two updates as indicated on the CDRL.

b. Establish a parts and materials selection and control program to promote standardization and to ensure the minimum acceptable reliability requirements are met in conjunction with the design and fabrication of the (name) system. The program shall include the following:

(1) Program parts selection in accordance with MIL-STD-965 including the development of a Program Parts Selection List (PPSL) to be submitted for Navy approval in accordance with CDRL item number (specify).

(2) Use of standard electronic modules in accordance with MIL-STD-1378 in all new-design subsystems, components and equipment in the system.

(3) Advance approval by NOSC in accordance with Procedure I of MIL-STD-965 for all parts not included in the Navy approved PPSL which are proposed to be used in those subsystems, components and equipment which are designed and fabricated by the contractor and subcontractors. The contractor shall submit all requests for use of such parts in accordance with CDRL number (specify).

NOTE: Paragraph 3.1.15.5.1b expresses the absolute minimum requirements for a parts and materials selection and control program. A preferred, more complete parts and materials program, one which specifies minimum component quality levels, is described in Paragraph 3.3.1.4.1a. This requirement is strongly recommended for Navy electronic equipment programs in the full-scale development phase. Also see Paragraph 3.1.15.1.9.

---

*Suitable for direct inclusion in a contract Statement of Work

c. Conduct a failure modes, effects and criticality analysis (FMECA) in accordance with MIL-STD-1629. Failures which cause total system shutdown or mission abort shall be investigated further to determine design improvements required to eliminate failure causes or reduce risks to acceptable levels. The FMECA plan and analysis results shall be documented in accordance with CDRL item(s) number(s) (specify) and submitted for Navy approval.

d. Conduct periodic reviews to evaluate the reliability requirements achievement as part of the overall design review process. A reliability review is to be conducted prior to each design review; the first such review is to be conducted when the prediction effort is completed. The reviews shall fulfill the requirements established in MIL-STD-785 and the results of the reviews shall be documented in the design review reports submitted in accordance with CDRL item number (specify). Inputs to the design review will include a worst case analysis and a sneak-circuit analysis where applicable.

e. A program for the identification and selection of suitable commercial equipment shall be established by the contractor whenever it is anticipated that commercial equipment will be incorporated into the system design. The goal of the program is to select those commercial equipment items whose operational availability (a function of reliability and maintainability) is optimum when considered on a total life-cycle cost basis. In this program the contractor is expected to perform design analysis, hardware inspection and reliability history investigation concerning the potential equipment candidates; results will be used to select the equipment items to be utilized in the design. The results of such investigations will be reported in connection with the design reviews and shall be summarized in interim and final reports, CDRL item number (specify). (The requirements for an appropriate commercial equipment selection program are outlined in Appendix N.)

f. Collect data during the test program (factory test and field tests) documenting the operating time, number of failures, time of failures and type of failures. A point estimate of the MTBF for the system will be calculated on a continuous basis. In the case of failure (either a failure of the system to meet mission requirements or the inability to complete a mission due to an equipment failure), the contractor shall identify the problem, apprise (name, code) and follow up with corrective action in the form of an engineering change proposal (ECP). The contractor also shall revise continuously the reliability prediction and perform failure modes and effects analysis on all redesigned equipment or component/part replacement. The procedures to be used for assessment and the results obtained shall be documented in accordance with the requirements of Exhibit A.

g. Institute a failure data collection analysis and corrective action reporting program in accordance with MIL-STD-785. The program shall meet the following requirements:

(1) All failures and suspected failures shall be recorded in a formal failure reporting and tracking data system.

(2) All failures shall be analyzed to the extent necessary to understand their causes. For contractor designed and fabricated equipment, detailed failure analyses of all equipment failures shall be conducted and failures

shall be isolated to the component level. Wherever possible, the contractor shall determine component failure mode and investigate need for redesign.

(3) All failures showing a repetitive pattern, all single point failures and all failures of high criticality, as indicated by the FMECA, shall be corrected by redesign. The contractor's data collection program shall be described in the reliability program report. Copies of failure reports describing all incidents of system failure during operations, maintenance and testing prior to delivery of the system to the procuring activity shall be submitted in accordance with CDRL item number (specify).

h. After completion of all qualification tests and when engineering data analysis indicates that the specified reliability requirements can be achieved, the contractor shall conduct a reliability demonstration. Test plans in MIL-STD-781 or sampling plans in MIL-STD-105 (for one-shot devices) are applicable. The contractor shall ensure that the test scoring rules (i.e., failures and test time that counts) are formalized and are representative of service use. To the maximum practical extent, the tests shall be conducted under environmental and operational conditions, including preventative maintenance, in accordance with the specified mission profile and shall be conducted in accordance with the (name) system development specification (title, number). The reliability demonstration test plan, test procedures, test report and any necessary corrective action plan shall be documented as specified in CDRL item numbers (specify) and shall be submitted for Navy approval.

*3.1.15.5.2 Maintainability Program

The contractor shall establish and maintain a maintainability program in accordance with MIL-STD-470 and the requirements listed below. The objective of the maintainability program shall be to assure that the maintainability requirements as stated in the (name) system development specification are attained. The maintainability program plan shall be documented as specified in CDRL item number (specify) and shall be submitted for Navy approval. In conducting the maintainability program, the contractor shall:

a. Analyze the (name) system to identify maintenance problems and to determine alternatives to enhance the maintainability design of the system. Allocate or apportion the specified numerical maintainability requirements to the major subsystem elements (name the elements) and document such allocation in accordance with CDRL item number (specify). Maintainability predictions shall be accomplished in accordance with Procedure II of MIL-HDBK-472. Predictions shall be given in terms of mean-time-to-repair (MTTR) and planned maintenance personnel hours per operating hours. The results shall be documented and submitted in accordance with CDRL item number (specify).

b. Conduct periodic reviews to evaluate achievement of maintainability requirements as part of the design review process. The reviews shall fulfill the requirements established in MIL-STD-470 and the results of the reviews documented in the design review reports submitted in accordance with CDRL item number (specify).

---

*Suitable for direct inclusion in a contract Statement of Work

c. Develop system preventive maintenance tasks which will reduce the probability of unscheduled maintenance. The tasks shall be described and sequenced to achieve maximum efficiency in the maintenance process. The maintenance tasks shall be developed and documented in accordance with MIL-P-24534 and CDRL item number (specify). Documentation will be required for the maintenance requirements cards (MRC) (preliminary version) and maintenance index pages (MIP) (preliminary version).

d. When engineering data analysis indicates that the specified maintainability requirements can be achieved, the contractor shall perform a maintainability demonstration of the (name) system in accordance with the development specification (title, number). The test plan outlines in MIL-STD-471 are applicable. The tests shall be conducted under government witness. The maintainability demonstration plan, test procedures, test report and any necessary corrective action plan shall be documented as specified in CDRL item numbers (specify) and shall be submitted for Navy approval.

*3.1.15.5.3 Availability Program

In conjunction with the contractor's reliability and maintainability programs, provisions shall be established to provide operational availability (A_o) measures and to assist in making reliability/maintainability/supportability trade-off decisions. These availability measurement activities shall be reported as part of the reliability status report that is to be submitted in accordance with CDRL item number (specify). Guidance contained in NAVMAT Instruction 3000.2, "Operational Availability of Weapon Systems and Equipments" regarding the calculation of A_o, shall be followed.

3.1.15.6 Government-Industry Data Exchange Program

The Government-Industry Data Exchange Program (GIDEP) is a cooperative data exchange among government and industry participants seeking to reduce or eliminate excess time and mor , expenditures and improve system reliability by making maximum use of existing knowledge. The program provides an automatic means of exchanging certain types of data essential to the research, design, development, production and operational life cycle of systems and equipment.

By the urgent data request (UDR) system, a GIDEP participant such as NOSC may query all other GIDEP participants on specific parts, components, material and process data or solicit other critical information not available from other sources. A UDR form initiated by a participant is sent to the GIDEP operations center for distribution to all participants. Responses go directly to the person making the query. That person then summarizes these responses so they may be incorporated into the appropriate data bank. This is for future use by others and eliminates duplicate inquiries.

The ALERT system provides the GIDEP participants with identification and notification of actual or potential problems, non-random or failure trends on parts, components, materials, manufacturing processes, test equipment or

*Suitable for direct inclusion in a contract Statement of Work

safety problems (SAFE-ALERTS). The ALERT data constitutes a portion of the computerized failure experience data bank.

The program provides each GIDEP representative with a roster of all other representatives by name, organization and telephone number. The roster also contains points of contact within each major electronic parts and electronics test equipment manufacturer in the United States. Through information contained in the roster, the GIDEP representative has a vast array of knowledge and expertise and the opportunity to obtain assistance in resolving technical problems or to obtain additional details required to interpret a report.

NOSC Code 9311 acts as the Center's GIDEP representative.

3.1.16 SYSTEM SAFETY PROGRAM

In accordance with the requirements of NAVMATINST 4720.1, full approval of systems and equipment for service use (ASU) will not be granted until a systems safety program, conforming to MIL-STD-882 and including any required analyses and testing, has been completed. When explosives are utilized in the system or equipment, an explosive safety review and recommendation by the Weapon Systems Explosive Safety Review Board (WSESRB) also are required. Additionally, systems involving laser devices will be reviewed by the Laser Safety Review Board (LSRB) as discussed in NAVELEXINST 5100.12, "Navy Laser Hazards Prevention Program." In keeping with these requirements, an appropriate total system safety program should be developed in which design analyses, studies and testing will identify system performance limitations, failure modes, safety margins and critical operator tasks. All known facets of safety optimization, including design, engineering, education, management policy and supervisory control, should be considered in identifying and eliminating or controlling hazards. System safety management and engineering should be integrated with other management and engineering disciplines in the interest of achieving an optimum system design. Procedures for the development and integration of the system safety effort should be applied across the managing activity/contractor interface to assure the development of a system safety program that is consistent with overall system requirements.

NAVMATINST 5100.6 requires that all acquisition programs include a system safety program (SSP) sufficiently comprehensive to ensure that system hazards are identified and controlled. NOSCINST 5100.3 emphasizes this requirement. MIL-STD-882 requires that a system safety program plan (SSPP) be developed for all major programs.

3.1.16.1 System Safety Activities During Various Program Phases

MIL-STD-882 describes the system safety program requirements for each of the various phases of the system life cycle for major systems acquisition efforts. When the system program is not designated as a major one, the phases will be related to the major system life cycle phases to determine the safety tasks required. The system safety program requirements relating to each life cycle phase shall be applied selectively annd tailored to the intended system use. In all cases, the system safety program should be developed to facilitate the system safety effort continuing into subsequent phases of the life cycle sequence.

The recommendations in this section are oriented towards a major system development, but can (and should) be tailored to the particular type and size program. An effective system safety program includes management, design, engineering and testing elements, but the real degree of safety achieved in a system is directly dependent upon management emphasis. Such emphasis must start during the early planning stages for each system development. The SSP results are dependent upon the procuring agency's clearly stated contract objectives and requirements and the contractor's ability to translate these into functional hardware.

MIL-STD-882 provides uniform requirements and criteria for establishing, tailoring and implementing system safety programs and provides guidelines for preparing contract Statements of Work and system safety program plans. MIL-STD-882 provides requirements for a standard safety program and minimal instructions concerning the preparation of a plan for such a program. The requirements for management of a system safety program (whether Navy or contractor) are basically contained in the SSPP. The MIL-STD is not a "how-to-do-it" detailed specification, nor does it contain safety requirements for specific systems or projects. It provides the requirements and criteria baseline on which to tailor specific system safety requirements for each program. For this reason, the simple inclusion of MIL-STD-882 in a Statement of Work will not cause appropriate safety requirements to be incorporated "automatically" in the delivered system. Each provision of MIL-STD-882 must be considered by the acquisition program manager to determine the extent of applicability or supplementary requirements.

3.1.16.1.1 Conceptual Phase

System safety tasks applicable to the conceptual phase are those required to evaluate the alternative system concepts under consideration for development and establish the system safety program consistent with the identified mission need and life cycle requirements. System safety tasks should include the following:

a. Evaluate all material, design features, procedures and operational concepts and environments under consideration which will affect safety throughout the life cycle

b. Perform a preliminary hazard analysis (PHA) to identify hazards associated with each alternative concept

c. Identify possible safety interface problems

d. Highlight special areas of safety consideration, such as system limitations, risks and personnel-rating requirements

e. Review safe and successful designs of similar systems for consideration in alternative concepts

f. Define the system safety requirements based on past experience with similar systems

g. Identify safety requirements that may require waiver during the system life cycle

h. Identify any safety design analysis, test, demonstration and validation requirements

i. Document the system safety analyses, results and recommendations for each promising alternative system concept

j. Prepare a summary report of the results of the system safety tasks conducted during the program initiation phase to support the decision-making process

k. Tailor the system safety program for the subsequent phases of the life cycle and include detailed requirements in the appropriate demonstration and validation phase contractual documents.

3.1.16.1.2 Validation Phase

System safety tasks during the validation or advanced developm . phase will be tailored to programs ranging from extensive study and analy through hardware development to prototype testing, demonstration and valida ... System safety tasks should include the following:

a. Prepare or update the SSPP to describe the proposed integr system safety effort planned for the demonstration and validation phase

b. Perform or update the PHA performed during the conceptual phase; prepare a PHA report of the proposed system concept in its intended use and operational environment

c. Identify those technology, design, production and operational and support (O&S) risks having an impact on safety

d. Establish system safety requirements and criteria for verifying that requirements have been met

e. Participate in trade-off studies to reflect the impact on system safety requirements and risk; recommend system design changes based on these studies to ensure that the optimum degree of safety is achieved consistent with performance and system requirements

f. Identify for inclusion in the appropriate specifications any qualitative and quantitative system safety requirements for the system; include contractor-furnished, government-furnished, ground support and all interfacing and ancillary equipment

g. Perform subsystem, system and Operational and Support (O&S) hazards analyses

h. Review all test plans to ensure safe conduct of the tests

i. Ensure that hazards identified by analyses and tests are eliminated or controlled

j. Review training plans and programs for adequate safety considerations

k. Evaluate results of failure analyses and mishap investigations recorded during the demonstration and validation phase; recommend redesign or other corrective action

l. Ensure that system safety requirements are incorporated into the system specification based on updated system safety studies, analyses and tests

m. Prepare a summary report of the results of the system safety tasks conducted during the demonstration and validation phase to support the decision-making process

n. Continue to tailor the system safety program; prepare an SSPP for the full-scale development phase

3.1.16.1.3 Full-Scale Development Phase

The system safety tasks during the full-scale development phase should include the following:

a. Ensure effective and timely implementation of the SSPP

b. Review preliminary engineering designs to ensure that safety design requirements are incorporated and that hazards identified during the demonstration and validation phases are eliminated or controlled

c. Update system safety requirements in system specifications

d. Perform or update subsystem, system and O&S hazard analyses and safety studies concurrent with the design/test effort to identify design and O&S hazards. Recommend any required design changes and control procedures

e. Identify testing facilities, test requirements, specifications and criteria to ensure that design safety is verified; review the test plans and programs to ensure safe conduct of the tests

f. Participate in technical design and program reviews and present results of subsystem, system and O&S hazard analyses

g. Identify and evaluate the effects of storage, shelf-life, packaging, transportation, handling, testing, operation and maintenance on the safety of the system and its components

h. Evaluate results of failure analyses and mishap investigations recorded during full-scale development; recommend redesign or other corrective action

i. Identify, evaluate and provide safety considerations for tradeoff studies

j. Review appropriate engineering documentation (drawings, specification, etc.) to ensure safety considerations have been incorporated

k. Review and provide safety inputs to preliminary system operation and maintenance publications

l. Verify the adequacy of safety and warning devices, life support equipment and personal protective equipment

m. Provide safety inputs to training courses

n. Review the preliminary production engineering effort including purchase specifications, process quality control, inspection and acceptance and test procedures to ensure that safety in the process and end product is established and maintained during production

o. Ensure requirements are developed for demilitarization and for the safe disposal of hazardous materials and equipment

p. Prepare a summary report of the results of the system safety tasks conducted during the full-scale development phase to support the decision-making process

q. Tailor system safety program requirements for the production and deployment phase

3.1.16.1.4 Production and Deployment Phases

As part of the on-going system safety program, the system safety tasks during the production and deployment or operational phases should include the following:

a. Prepare or update the SSPP to reflect the system safety program requirements for the production and operational phases

b. Identify critical parts and assemblies, production techniques, assembly procedures, facilities, testing and inspection requirements which may affect safety and will ensure:

(1) Adequate safety provisions are included in the planning and layout of the production line to establish safety control of the system within the production process and operations

(2) Adequate safety provisions are included in inspections, tests, procedures and checklists for quality control of the equipment being manufactured so that safety achieved in design is maintained during production

(3) Production technical manuals or manufacturing procedures contain required warnings, cautions and special procedures

c. Verify that testing and evaluation are performed on early production hardware to detect and correct safety deficiencies at the earliest opportunity

d. Review test plans and programs to ensure the tests are conducted safely

e. Review warnings, cautions and special procedures required for safe operation and maintenance

f. Review procedures to store, package, handle and transport to ensure that safety in maintained

g. Review procedures and monitor results of periodic field inspections or tests (including recall-for-tests) to ensure acceptable levels of safety are maintained; this includes identifying major or critical characteristics of safety significant items that deterioriate with age, environmental conditions or other factors

h. Update hazard analyses to identify any new hazards that may result from engineering changes; ensure that the safety implications of the changes are considered in all configuration control actions

i. Evaluate results of failure analyses and mishap investigations; recommend corrective action

j. Monitor the system throughout the life cycle to determine the adequacy of the design and operating, maintenance and emergency procedures

k. Conduct a safety review of proposed new operating and maintenance procedures, or changes, to ensure that the procedures, warnings and cautions are adequate and inherent safety is not degraded; these reviews should be documented as updates to the O&S hazards analyses

l. Analyze safety deficiency reports submitted by operating and support personnel

m. Review capability and procedures for demilitarization and disposal of hazardous material and equipment

n. Document hazardous conditions and system deficiencies for development of follow-on requirements for modified or new systems

o. Update safety documentation, such as design handbooks, military standards and specifications, to reflect safety "lessons learned"

3.1.16.2 Inclusion of Appropriate System Safety Requirements in Contracts

In planning contractual requirements for system safety, it should be noted that MIL-STD-882A intends that a total program be developed in which design analyses, studies and testing will identify system performance limitations, failure modes, safety margins and critical operator tasks. All known

facets of safety optimization including design, engineering, education, management policy and supervisory control are expected to be considered in identifying and eliminating or controlling hazards. System safety management and engineering should be integrated with other management and engineering disciplines in the interest of an optimum system design. Procedures for development and integration of the system safety effort should be applied across the managing activity/contractor interface to assure a system safety program consistent with overall system requirements.

The following provides recommended contractual requirements statements, based on MIL-STD-882A, for major systems entering either the validation or the full-scale development phases.

*3.1.16.2.1 System Safety Program

The contractor shall plan, implement and maintain a system safety program (SSP) which is integrated effectively with the development effort. The provisions of MIL-STD-882 shall be directly applicable except as modified here. The primary purpose of the SSP effort shall be to identify, correct and/or control hazards during the design process. During the contractual period the SSP shall be so established as to enable it to continue into later phases of the system life cycle. The SSP shall include but not be limited to:

a. System safety as an essential element of program management

b. System safety engineering analysis as a specific process leading to comprehensive design hazard identification

c. The establishment and communication of system safety criteria and information within the program organization

d. System safety as a requisite element of system testing and verification

e. Closed-loop system for action on identified hazards to ensure timely resolution

The contractor shall prepare a system safety program plan (SSPP), describing in detail how the safety program will be conducted to comply with the requirements. The plan shall clearly delineate those tasks to be performed by the contractor and those to be performed by subcontractors.

The SSPP shall be structured in a consistent manner and shall be arranged in the following format (additional sections may be included at the contractor's option):

a. Introduction, scope and purpose

b. Organization for management and control, including key personnel and system safety experience

*Suitable for direct inclusion in a contract Statement of Work

c. Overall program schedule and milestones

d. Detailed description of each system safety task

e. Resources (personnel and facilities) to be allocated for the system safety program

The SSPP must be specific with regard to the requirements and conduct of the general unique efforts for the program requirements specified here. Particular emphasis shall be directed toward the methods and techniques to assure that the program objectives will be attained by adequate management controls and coordination with other disciplines. Each task to be performed shall be addressed independently:

a. The contractor's organizational element responsible for the performance of the task and the interrelationships and functions of other participating organizational elements, including data typically exchanged; this requirement is also applicable to subcontractors

b. A complete description of the task including the methodology for accomplishment

c. The time frame allocated for the accomplishment of the task, including interrelationships with other program schedules and system safety tasks and report milestones

d. Documentation, including a description of the contractor's internal controls, data recording formats and contractually required reports

e. Resources to be allocated for the implementation of each task

The plan shall clearly delineate those tasks to be performed by the contractor and those to be performed by subcontractors.

The plan shall be prepared in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

***3.1.16.2.2 System Safety Hazard Analyses**

The contractor shall perform safety hazard analyses to identify hazardous conditions and ensure their elimination or control. Analyses shall be performed to examine systematically the various elements (equipment, computer software, etc., as applicable) of the system and their interrelationships including logistics, training, maintenance, testing, modification and operational environments.

The following specific tasks shall be performed (specify the hazard analyses applicable to the system and the phase of development):

a. Preliminary hazard analyses

---

*Suitable for direct inclusion in a contract Statement of Work

b. Subsystem hazard analyses

c. System (interface) hazard analysis

d. Operating and support hazard analyses

The above hazard analyses shall be supplemented with a fault hazard analysis, fault tree analysis (specify those other analyses which are appropriate to the system and the phase of development; see Paragraph 3.1.16.2.4 for description of these various analyses).

***3.1.16.2.2.1 Preliminary Hazard Analysis**

The contractor shall perform a preliminary hazard analysis (PHA) in accordance with the requirements of MIL-STD-882. The PHA will consist additionally of an analysis of similar system historical (weapon system, missile, warhead, rocket motors, etc.) mishap data (lessons learned) to identify hazards, establish generic hazard rates and provide minimum safety functional requirements for design groups and specifications. Applicable hazards identified by the PHA shall be addressed in design specification documents. The analysis shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

***3.1.16.2.2.2 Subsystem Hazard Analysis**

The contractor shall perform a subsystem hazard analysis (SSHA) in accordance with the requirement of MIL-STD-882 and shall include a failure modes, effects and criticality analysis expanded to assess hazardous modes. The contractor may use the following techniques to complete the SSHA as required:

a. Fault hazard analysis

b. Fault tree analysis

c. Sneak circuit analysis

These analyses shall be performed to that level necessary to identify hazards, their relationships with other parts of the system or subsystem and their classification. Unresolved critical or catastrophic hazards not within the contractor's capability to resolve shall be reported to the procuring agency in a timely manner. The analysis shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

***3.1.16.2.2.3 System (Interface) Hazard Analysis**

The contractor shall perform a system (interface) hazard analysis in accordance with the requirements of MIL-STD-882. The analysis shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

---

*Suitable for direct inclusion in a contract Statement of Work

*3.1.16.2.2.4 Operation and Support Hazard Analysis

The contractor shall perform an operating and support hazard analysis in accordance with the requirements of MIL-STD-882. The analysis shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

*3.1.16.2.3 Safety Analyses Time-Phasing

The contractor shall time-phase the qualitative and quantitative safety analyses with major program decision milestones. The preliminary hazard analysis shall be completed and available and an initial subsystem hazard analysis shall be provided to support the preliminary design review. Subsystem hazard analysis shall be 90 percent complete and made available to the government (specify) working days prior to the critical design review (CDR). The operating hazard analysis shall be completed (specify) working days before the start of OPEVAL (when in the full-scale development phase). An assessment of the quantitative system safety level shall be provided for PDR, CDR, OPEVAL (specify) working days prior to delivery of the first unit to the Navy. These analyses shall be updated to reflect approved design changes and made available (specify time).

3.1.16.2.4 Description of Various System Safety and Reliability Program Analyses

Those various analyses often performed in connection with system safety and reliability program efforts are described in the following:

a. Sneak Circuit Analysis (SCA). The SCA is performed to identify and correct latent electrical paths which could cause an undesired function without regard to component failure and create a potentially hazardous condition. The SCA also should be performed on any computer software associated with the system operation to identify and correct logic sequences which could cause an undesired function or inhibit a desired function without regard to component failure and create a potentially hazardous condition.

b. Failure Modes, Effects and Criticality Analysis (FMECA) See Paragraph 3.1.15.1.4.

c. Fault Hazard Analysis (FHA). The FHA is similar to the FMECA but searches for additional failures such as those caused by human error, design and deficiencies, procedural deficiencies, abnormal environments and components that could cause normal functioning at the wrong time and could independently, or in combination, serve to increase the probability of a hazardous occurrence.

d. Fault Tree Analysis (FTA). The FTA, or deductive safety analysis, techniques provide the most effective and sophisticated approach to predictive safety analyses currently available to the safety professional. The basic concepts involved can be used to perform simple, qualitative evaluations to

*Suitable for direct inclusion in a contract Statement of Work

very complex, quantitative studies (requiring specialized training, computer programs and experience to conduct). The expense of performing such studies increases proportionally with the complexity and scope of the effort. Therefore, selective judgment is needed in planning the analytical effort to be initiated to assure that its cost is justified by the hazard risk being evaluated.

e. Hazards of Electromagnetic Radiation to Ordnance (HERO) Analysis. HERO analysis evaluates the hazards of electromagnetic radiation to the electroexplosive devices (EEDs) of the system, generally, a weapon system. The likelihood of rf energy transfer to the EEDs is greatest during the handling, loading and testing phases when preparing the weapon system for launch. Therefore, a HERO-safe weapon system design must protect all electrically-initiated components from electromagnetic radiation when the system is employed in its expected environment.

HERO studies and tests may be scheduled as soon as the design has reached the point at which EEDs are selected. The specifications for HERO considerations in circuit design are contained in MIL-STD-1385. Other design considerations are discussed in OD 30393 (Design Principles and Practices for Controlling HERO).

f. Radiation Hazard (RADHAZ) Analysis. Analysis of radiation hazards involves two types of radiation which are hazardous to humans: ionizing radiation, primarily x-rays, and radio frequency electromagnetic radiation. In addition to their generation from x-ray machines used for medical purposes or for the inspection of welds and castings, x-rays also are generated in conjunction with most high power radio and radar transmissions.

g. Laser Safety Analysis. Lasers transmit non-ionizing, electromagnetic energy in or near the visible light spectrum. The energy is focused in a narrow beam which remains highly concentrated over long distances. This high-energy concentration presents hazards to personnel, explosives and fuels. The human eye is very susceptible to damage by laser light, since the retina or cornea may absorb sufficient energy to cause permanent damage.

3.1.17 QUALITY ASSURANCE PROGRAM

A significant portion of Sections 3.1, 3.2, 3.3, 3.4 and 3.5 of this guide deals with a number of traditional hardware quality oriented product assurance program elements which should be considered by the project manager for inclusion in his program on a carefully selected basis. While the large majority of these elements normally would be included in a good, comprehensive quality assurance program, the project manager cannot assume that a development or production contractor automatically will include them. Therefore, the manager is encouraged to stipulate in the contract Statement of Work those specific quality program requirements, recommended in this document, that he wants to have included or emphasized in the contractor's quality assurance program. However, it is recognized that the project manager may wish to avoid specifying individual quality program requirements, preferring instead to invoke the familiar MIL-Q-9858 quality assurance program requirement. In this case, it is recommended that the MIL-Q-9858 requirement, which provides only

general quality program guidance, be strengthened with the addition of a quality assurance program supplement similar to that provided in Appendix G. It might also be strengthened by adding selected quality program requirements as suggested in Sections 3.1, 3.2, 3.3, 3.4 and 3.5. A recommended contractual requirements statement for a quality assurance program based on MIL-Q-9858 and supplemented by Appendix G is provided in Paragraph 3.1.17.3.1 (also see Paragraph 3.4.2).

3.1.17.1 Comparison of the MIL-Q-9858 and the MIL-I-45208 Requirements

Certain procurements, such as those involving the development or manufacture of simple, non-complex equipment items, may not require the full provisions of MIL-Q-9858. In such instances, the inspection system provisions of MIL-I-45208 may be sufficient. To assist the project manager, the following provides a comparision of the MIL-Q-9858 quality assurance program requirement with the MIL-I-45208 inspection system requirement.

a. <u>MIL-I-45208 (Inspection System Requirements)</u>. Requires the contractor to control inspections and tests as necessary to assure the product conforms to drawings, specifications and contract requirements. Recommended for non-complex equipment items.

b. <u>MIL-Q-9858 (Quality Program Requirements)</u>. Requires the contractor to have a total quality program wherein <u>work operations and manufacturing processes are fully controlled, along with the inspections and tests</u>. The purpose is to assure the physical and functional compatibility of produced hardware items which comprise major equipments, subsystems and systems. Recommended for complex equipment items.

Additionally, MIL-Q-9858 includes the following provisions which are not found in MIL-I-45208:

- Organization of the quality staff with defined responsibilities/ authority
- Initial planning to assure product quality
- Maintenance and use of quality cost data
- Identification of advanced metrology requirements
- Handling, storage and delivery instructions
- Bailed property procedures

3.1.17.2 Quality Assurance Activities During Various Program Phases

Aside from the preparation of quality assurance plans and the independent verification of the quality of produced products and services provided, the quality assurance function during all phases of the life cycle is one of constant review and monitoring of all activity relating to product quality. Table 3.4 provides a general overview of the activities involved.

PHASE	CONCEPTUAL	VALIDATION	FULL-SCALE DEVELOPMENT	PRODUCTION	DEPLOYMENT
MILESTONE	0 (Program Initiation)	I (Demonstration and Validation)	II (Full-Scale Development)	III (Production and Deployment)	
PHASED QUALITY ASSURANCE ACTIVITIES	• Review approved Mission Element Need Statement • Review parametric data on similar systems • Perform analysis for determining minimum essential quality characteristics • Develop initial QA plans • Perform quality assessment	• Identify and define those characteristics which enhance product quality • Evaluate inhouse or contractor proposals for full-scale development • Prepare contract provisions for QA during full scale development • Identify special acceptance inspection equipment (SAIE) requirements for full-scale development • Develop metrology and calibration plan for the product during full-scale development • Perform independent quality assessment of produced products • Update and refine quality requirements and QA plan for development	• Perform producibility and quality engineering analysis Review manufacturing, special production processes, and quality control methods Identify critical items Review critical item planning Identify potential problem areas risks Review SAIE • Review the design for the enhancement of quality Identify and initiate cost effective engineering changes Evaluate rate & assembly operations for ease of examination and test Review test procedures • Prepare contract provisions for QA during production • Review plans to prevent degradation of quality during production • Perform independent quality assessment of produced products	• Ensure baseline control of engr. changes and configuration • Provide for monitoring of contractor or inhouse quality • Provide inputs to production to enhance quality • Provide quality audits of products and services • Review depot maintenance work requirements • Review product acceptance plans for deploy user activities • Review data feedback system for deployment phase • Review product quality training programs — user orientation • Review logistics provisioning QA program • Update QA plans as necessary • Perform independent quality assessment of produced products	• Monitor initially deployed system (assure user satisfaction) • Monitor implementation of storage and distribution QA plans • Monitor implementation of operations QA plans • Monitor implementation of military service QA plans for maintenance and overhaul • Monitor implementation of storage serviceability standards and cycle inspection instructions • Perform independent quality assessment of deployed systems and of data feedback system **DISPOSAL** • Review phase-out and disposal plans QA Plan Decontamination Sales
CONTINUING QUALITY ASSURANCE ACTIVITIES	Assess Quality of Weapon Systems To Identify Requirements, Achievements, Needed Quality Improvements and Unsatisfied Needs				
	Monitor Quality Assurance Programs for Services Procured Relative to Systems Acquisition and Deployment				
		Ensure Uniformity of Specifications, Standards, and Data Requirements Related to Quality Assurance			
		Ensure Provision of Metrology and Calibration Services			
	Monitor Quality Data Feedback and Utilization				

Table 3.4. Quality assurance (QA) program activities associated with major system acquisition and deployment.

3.1.17.3 Inclusion of Appropriate Quality Assurance Requirements in Contracts

*3.1.17.3.1 Quality Assurance Program

The contractor shall establish and maintain a quality assurance program meeting the requirements of MIL-Q-9858 and MIL-S-52779 (if computer software is involved) as modified by the quality assurance program requirements supplement (see Appendix G) included in this document. The program shall ensure that both hardware and computer software conform to quality requirements throughout all areas of contract performance. The requirements of MIL-Q-9858, MIL-S-52779 and the quality assurance program requirements supplement provided as Appendix (specify) shall be passed on to all developers/fabricators of major equipment/subsystems unless the contractor requests and the Government approves otherwise. A quality assurance program plan shall be prepared to indicate the means whereby compliance with the requirements of the contract will be accomplished. The plan shall be prepared in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

3.1.18 HUMAN FACTORS PROGRAM

A high level of system operational effectiveness can be achieved only through treating equipment, software and personnel as a unified system. System failures, resulting from exceeding the capability of the human element, degrade operational effectiveness as certainly as equipment malfunctions or design deficiencies. NAVMATINST 3900.9 and MIL-H-46855A require a human engineering program as an integral part of any system or equipment development effort where personnel are expected to be involved in either the operation or direct support of the system or equipment.

As required by NAVMATINST 3900.9, a human engineering program should be implemented by the project office to achieve the required degree of human-machine integration. As a minimum, the program should include the following:

a. Human Engineering Plan. A realistic and enforceable human engineering (HE) plan should be formulated early during the conceptual, validation and development phases. To achieve cost effectiveness, the plan should reflect an effort tailored specifically to the system and its phase of development. A description of the tasks to be performed, HE milestones, methods to be used and test and evaluation factors should be included. The plan should reflect an integrated effort within the total program. It should provide specific information to show what tasks are to be performed and when, relative to the overall program schedule of events.

b. Scheduling. The HE effort should be scheduled as an integral part of the overall program. The schedule should take task interrelationships into account and ensure that timely design inputs are provided.

c. System Analysis. The goal of HE system analysis is to ensure appropriate division of system functions between the equipment and personnel and to

*Suitable for direct inclusion in a contract Statement of Work

describe the tasks required of operator and support personnel to carry out their assigned functions. Accordingly, HE tasks should be formulated using the guidance of MIL-H-46855A to identify, analyze and allocate candidate operation and support tasks to the personnel elements of the system. Since operational and support tasks performed by system personnel increasingly are influenced by the characteristics of system software, systems analysis procedures should be developed to ensure that human capabilities and limitations are considered in the design. Operator and maintenance personnel characteristics should be defined in sufficient detail to guide equipment design and to develop personnel, training and life support requirements.

d. Human Engineering in Equipment and Ship or Shore Station Design. Detailed HE design criteria documented in MIL-STD-1472B and data developed in the HE system analysis activity should be incorporated in detailed equipment and crew station design.

e. Test and Evaluation. Evaluation and validation of system or equipment HE design aspects are important elements of the overall testing program. Accordingly, HE test procedures and criteria should be developed and incorporated in the testing program to verify that appropriately trained Navy personnel effectively can operate, maintain and support the system or equipment within its intended operational environment.

f. Program and Design Reviews. HE program and design reviews should be conducted as a part of the overall review activity. Each major review (e.g., PDR, DCR) should include consideration of HE design aspects.

g. Configuration Management. Procedures should be initiated to ensure that design changes occurring during the system life cycle do not significantly degrade the HE design concept.

h. Non-duplication. All related program activities (e.g., safety, maintainability, training) should be reviewed to eliminate any redundant effort.

i. Contractual Requirements. Programs for the development of all systems having a human-machine interface should include an identifiable human engineering program. The following provides a recommended contractual requirements statement for a system in the full-scale development phase.

3.1.18.1 Inclusion of Appropriate Human Engineering Requirements in Contracts

*3.1.18.1.1 Human Engineering Program

The contractor shall establish and maintain a human engineering program throughout full-scale development of the (name) system. The objective of the program will be to ensure that human factors are considered in the design and fabrication of the hardware and software in both operational and maintenance

*Suitable for direct inclusion in a contract Statement of Work

aspects. The human engineering program shall meet the requirements of MIL-STD-1472B and MIL-H-46855. A human engineering program plan shall be prepared to indicate the means whereby compliance with the requirements of the contract will be accomplished. The plan shall be prepared in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

(Note: The additional requirements of preparing a Human Engineering Dynamic Simulation Plan, a Human Engineering Test Plan and Final Reports may be added if appropriate.)

3.1.19 PROCUREMENT DATA (ENGINEERING DRAWINGS, SPECIFICATIONS, ETC.)

While not a traditional product assurance program concern in many sectors, the importance of the procurement (i.e., production) data, one of the major end products of the development process, cannot be overstated. Procurement data include all those documents which will be used to fabricate the system in production and which will be used to verify the quality of the resultant production units. Procurement data include engineering drawings, drawing and parts lists, special or unique manufacturing procedures or processes (see Paragraph 3.3.7.1), special quality assurance requirements and material, process and product specifications.

3.1.19.1 Inclusion of Appropriate Procurement Data Requirements in Contracts

The engineering drawing is the document which identifies the details of the design of a part or item of equipment and establishes its functional or performance requirements. DOD-D-1000B identifies three levels of engineering drawings: Level 1 (conceptual and developmental design); Level 2 (production prototype and limited production) and Level 3 (production).

3.1.19.1.1 Level 1 Drawings - Conceptual and Developmental Design

Engineering drawings and associated lists prepared to this level disclose engineering design information sufficient to evaluate an engineering concept and may provide information sufficient to fabricate developmental hardware. Engineering drawings and associated lists prepared to Level 1 are required to be legible and include those types of drawings most amenable to the mode of presentation. Layout drawings and combinations of types of engineering drawings may be used to convey the engineering concept in such a manner that the engineering information is understandable to cognizant government engineers and scientists or to enable the design contractor to fabricate developmental hardware for test or experimentation. The requirements of DOD-STD-100 do not apply unless so specified.

3.1.19.1.2 Level 2 Drawings - Production Prototype and Limited Production

Engineering drawings and associated lists prepared to this level shall disclose a design approach suitable to support the manufacture of a production prototype and limited production models. Level 2 engineering drawing types include, as applicable, parts lists, detail and assembly drawings, interface control data, diagrams, performance characteristics, critical manufacturing limits and details of new materials and processes. Special inspection and test requirements necessary to determine compliance with requirements for the

item are defined on the engineering drawings or referenced to a document acceptable to the government. The requirements of DOD-STD-100 apply unless otherwise specified.

3.1.19.1.3 Level 3 Drawings - Production

Engineering drawings and associated lists prepared to this level provide engineering definition sufficiently complete to enable a competent manufacturer to produce and maintain item quality control. This will be to the degree that physical and performance characteristics, interchangeable with those of the original design, are obtained without resorting to additional product design effort, additional design data or recourse to the original design activity. The requirements of DOD-STD-100 apply. Level 3 engineering drawings are expected to:

a. Reflect the end-product

b. Provide the engineering data for the support of quantity production

c. Provide the necessary data in conjunction with other related reprocurement data to permit competitive procurement of items substantially identical to the original item(s)

3.1.19.1.4 Application of Level 2 and Level 3 Drawing Requirements

If the production units of equipment to be designed are expected to be procured in a competitive, industrial environment then the engineering drawings should be prepared to the Level 3 requirements. Such is the case, for example, with later purchases (beyond the initial supply) of spare or provisioned parts. If the production units are certain to be procured from the original development contractor and reprocurement of systems beyond the original production clearly is not anticipated, then Level 2 drawings are appropriate, except for the systems' spare parts which always should be documented to the Level 3 standards.

Appendix H provides an example of appropriate contractual requirements for both hardware procurement data and computer software, where the original developer will fabricate the production units on a one-time, limited basis justifying the preparation of Level 2 drawings (except for spare parts). Paragraph 3.1.19.2 provides an implementing clause.

3.1.19.1.5 Drawing "Ordering Data"

Appendices I, J and K provide suggested "ordering data" for Levels 1, 2 and 3 drawings. "Ordering data" is that drawing preparation information which must be provided in accordance with Paragraph 6.2.1 of DOD-D-1000. Such information normally is referenced in Block 16 of the CDRL and attached thereto.

3.1.19.1.6 Classification of Characteristics

DOD-STD-2101 establishes a policy for the classification of characteristics (CCs) of ordnance equipment items which are expected to be items of separate procurement or are expected to be procured as spare or repair parts.

Basically, the standard describes the procedure for annotating the engineering drawings or specifications (if applicable) describing such parts so as to indicate the criticality of the parts various physical and functional features, i.e., characteristics. This information is useful and instructive to both the future producer of the part, who would have little or no knowledge of its application, and to the government representative responsible for its inspection and acceptance. DOD-STD-2101 encourages the use of notes on drawings having classified characteristics which explain the use of the classifications and which establish acceptance requirements pertaining to them. Appendix L provides a recommended note to be included on drawings having classified characteristics. The acceptable quality levels (AQLs) specified in the note may be adjusted as appropriate to the equipment item.

The use of classification of characteristics is applicable to either DOD-D-1000 Level 2 or 3 drawings. However, it is recommended that anticipated fleet spare or provisioning parts always be documented to the Level 3 requirements.

If the Appendix L note is utilized, it is recommended that such a note be preprinted on adhesive film so as to avoid having to add the note by manual methods (printing or typing). Such preprinted notes should be sized to accommodate the drawing size, taking into consideration the anticipated reduction of microfilm reproducibles.

*3.1.19.2 Procurement Data Package Requirements

The contractor shall develop and provide a procurement data package, CDRL item number (specify), which can be used in the production phase to manufacture the (name) system. The package shall consist of engineering drawings (CDRL item number (specify)) and specifications (CDRL item number (specify)) conforming to DOD-D-1000 and MIL-S-83490, respectively, as defined in the procurement data package requirements attachment (specify number - see Appendix H) to this Statement of Work. The package shall reflect all changes required as a result of developmental testing and TECH/OPEVAL. In addition, the contractor shall develop and provide an installation data package, CDRL item number (specify), for the integration and installation of the system in the TECH/OPEVAL test platform. Also, the contractor shall develop and maintain a specification "tree" (CDRL item number (specify)) and a drawing "tree" (CDRL item number (specify)) as described in the procurement data package requirements attachment.

All engineering drawings documenting components, subassemblies or assemblies, expected to be reprocured as spare or provisioned parts supplied to organization or intermediate maintenance activities, shall be documented to the DOD-D-1000, Level 3 requirements. They shall have all physical and functional interface characteristics classified in accordance with DOD-STD-2101. All drawings having characteristics classified in accordance with DOD-STD-2101 shall include the note of attachment (specify number - a suitable note is included as Appendix L).

---

*Suitable for direct inclusion in a contract Statement of Work

In preparing the engineering drawings the contractor shall observe the drawing procurement requirements (DOD-D-1000, Paragraph 6.2.1) provided as attachments to the CDRL. All engineering drawings, specifications and their associated "trees" shall be submitted for Navy approval.

***3.1.19.3 Use of Limited Rights or Proprietary Equipment and Data**

No equipment or data of proprietary nature shall be included in the design without prior written approval of the procuring activity. Restrictive markings on drawings and associated lists shall be used only when authorized by the terms of the "Rights in Technical Data and Computer Software" clause of this contract. This requirement applies also to drawings by vendors or subcontractors submitted under this contract. In the event that the contractor has not provided a complete list of the proprietary data and items he intends to use during development and production with his proposal or bid, he shall provide such a list to the procuring activity within 45 days after contract award. Should no list be provided, all equipment and data required to be delivered under the terms of this contract shall be delivered with unlimited rights.

3.1.20 SPECIAL PACKAGING PROGRAM

Often overlooked in the full-scale development phase is the need to design/develop that special packaging necessary to ensure that items of equipment are not damaged during shipment or storage. The requirement to design/develop such special packaging should be included in any full-scale development effort involving equipment, or spare parts thereof, which cannot be shipped confidently or stored when packaging in accordance with commercial practices.

***3.1.20.1 Packaging, Handling, Storage and Transportability Program**

The contractor shall establish a packaging, handling, storage and transportability (PHST) program in accordance with MIL-STD-1367. This program shall be planned and integrated into all phases of product development. Special packaging, i.e., containers, dunnage, etc., which may be required shall be developed, tested and documented. The engineering drawings describing such special packaging shall be prepared in accordance with CDRL item number (specify).

---

*Suitable for direct inclusion in a contract Statement of Work

3.2. PROCUREMENT

3.2 PROCUREMENT

The project manager is responsible for the adequacy of products developed by or purchased from contractors, including their conformance to quality, reliability, maintainability and system safety requirements. Therefore, contractual controls should be established and maintained to ensure that each contractor provides the required level of quality and reliability. Requirements and acceptance criteria should be imposed upon contractors using military specifications, where applicable. Purchase documents should specify the applicable procurement control requirements and responsibilities to be imposed progressively at subcontracting levels. The contractor's product assurance program should contain provisions for surveillance of subcontractor activities at sub-tiers to assure satisfactory performance, assist in problem solving and provide feedback for corrective action. This section provides guidance for the management of procurement during development and production whether by the NOSC project office or by a contractor and recommends contractual requirements for this activity. Table 3.5 provides an outline of technical data and product assurance elements which generally are present with typical types of procurements.

As with the balance of this document, it is stressed that not all the requirements of this section will apply to all projects and those that do apply may require tailoring or modification.

3.2.1 PROCUREMENT SOURCE

Except in those instances where a sole source procurement can be justified, the NOSC project manager only can recommend sources for his procurements. A contractor involved in a major system development or production effort, however, can and should be required to establish a system to evaluate and select his procurement sources.

*3.2.1.1 Selection of Procurement Source

The contractor shall establish and maintain a system to evaluate and approve procurement sources. The product assurance organization shall exercise review authority and provide comments on the adequacy of procurement sources. Among other factors, selection of contractors for each product shall be based on a positive determination of one of the following factors:

a. A record of supplying products of acceptable levels of quality and reliability of the type being procured; these records shall be supported by documented quantitative information

b. A survey of the facilities and product assurance program of the contractor if no previous quality and reliability records are available or if the contractor's past performance has been marginal; results of this survey shall be documented

---

*Suitable for direct inclusion in a contract Statement of Work

Procurement Type	Engineering drawings and associated lists (DOD-D-1000)	Engineering specifications (MIL-STD-490)	Classification of characteristics (DOD-STD-2101)	Technical manuals (various specifications)	Special manufacturing or process data	Quality assurance test & inspection plans (NAVSEA/NSI 4855-1a)	R, M, SS, ILS, QA, CM, program plans	Computer software (MIL-STD-1679)	Contractor's quality program inspection system (MIL-Q-9858 MIL-I-45208)	Contractor's inspection requirements (100 MIL-STD-105)	Piece part, first article, preproduction, periodic, samples inspection testing	Inspection and acceptance responsibility (NOSC DCAS)	Pre-award post-award surveys (NOSC DCAS)	Reliability (R) program elements (MIL-STD-785)	Maintainability (M) program elements (MIL-STD-470)	Integrated logistics support (ILS) elements (MIL-STD-1369)	System safety (SS) program elements (MIL-STD-882)	Configuration management (CM) (DOD-STD-480)	Comments
	Product Assurance Elements																		
	Selected Technical Data Items								Quality Assurance										
A. Purchase of commercial components, materials or equipment	NR	NR	NR	O	NR	NR	NR	NR	NR	NR	O	O	NR	NR	NR	NR	NR	NR	Product assurance requirements generally not applicable
B. Fabricate parts or equipment to navy drawings and/or specifications	NR	NR	NR	NR	NR	NR	O	NR	E	E	O	E	O	O	O	O	O	E	Quality assurance requirements should be included
C. Repair government designed documented components or equipment	NR	NR	NR	NR	NR	NR	O	NR	R	E	O	E	O	O	O	NR	O	E	Quality assurance requirements should be included
D. Repair contractor's own commercial components or equipment	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	O	O	NR	NR	NR	Product assurance requirements generally not applicable
E. Engineering services (e.g. design, drafting, technical manuals, other technical data, configuration management, ILS, reliability, maintainability, safety or other analyses, computer software)	E	E	R	R	O	O	O	E	NR	NR	NR	E	O	E	E	E	E	E	Technical data and other product assurance requirements should be included for the particular engineering service or product to be supplied
F. Research and development (i.e. integrated design documentation, fabrication, testing effort)	E	E	R	(1) E	R	R	E	(2) E	E	E	R	E	R	E	E	E	E	E	Technical data and product assurance requirements should be included as appropriate

NR Inclusion in the procurement requisition of a product assurance or technical data requirement pertaining to this subject generally is not required or appropriate

O Inclusion of technical requirements is optional

R Inclusion of technical requirements is recommended

E Inclusion of technical requirements is essential

Table 3.5. Outline of product assurance and selected technical data requirements elements which generally are present with typical types of procurements and for which technical requirements should be included in the procurement requisition.

c. Tests and inspections to determine conformance to requirements when products are not designed and produced specifically for the designated application; in such cases, the contractor shall document the results of the tests and inspections as the basis for source approval

3.2.2 APPROVED SOURCE LIST

Whether engaged in development or production, a contractor should be required to maintain an approved source list from which he selects subcontractors or other suppliers.

*3.2.2.1 Approved Source List of Subcontractors

The product assurance performance of each subcontractor shall be objectively evaluated on a continuing basis, utilizing available data from on-site surveys, source inspection, receiving inspection, fabrication and assembly operations. Approved source lists of subcontractors and their products shall be developed and used in the selection of subcontractors. Criteria for maintaining approved source lists, including the addition and removal of subcontractors, shall be documented. Procurements from sources other than those on approved source lists shall not be made without specific concurrence by the contractor's product assurance organization.

3.2.3 SURVEYS/REVIEWS OF CONTRACTOR/SUBCONTRACTOR OPERATIONS

On-site product assurance surveys or reviews (in the past, referred to as audits) of prime contractors' operations are an important element in establishing the competency of a contractor prior to contract award. These surveys or reviews can be an important means of motivating a performing contractor to improve quality where it is found to be lacking. However, such surveys or reviews should be performed only when clearly necessary and then only after proper planning and preparation, including coordination with other affected government activities as well as the cognizant DCAS or NAVPRO. Paragraph 3.2.3.1 provides an overview of the various types of prime contractor surveys and reviews which may be performed and discusses their proper application.

On-site surveys of subcontractors' operations by the prime contractor is also an important element of the prime contractor's product assurance surveillance responsibility. Paragraph 3.2.3.2 is a suggested contractual requirement for the prime contractor to make periodic, scheduled on-site product assurance surveys of subcontractor operations.

3.2.3.1 Government Surveys/Reviews of Prime Contractor Operations

Government surveys/reviews of prime contractors include the Pre-Award Survey, the Post Award Conference, the Product Oriented Survey and the Quality System Review.

---

*Suitable for direct inclusion in a contract Statement of Work

3.2.3.1.1 Pre-Award Survey

The Pre-Award Survey (PAS) is an evaluation of a prospective contractor's ability to perform under the terms of a proposed contract. It covers those aspects of the contractor's management, finances and facility resources that are significant to the purchasing office in determining whether a contractor would be considered responsible. A PAS is requested when the information available to the contracting officer (purchasing office) is insufficient to make a determination as to the responsibility of a prospective contractor. According to DAR Paragraph 1-905.4 the PAS can be accomplished by:

a. Examination of available data concerning the contractor

b. Examination of data concerning the contractor which is obtained from another government agency or from a commercial source

c. Conducting an on-site inspection of plant and facilities to be used for performance of the proposed contract

d. Combination of the above. DAR Appendix A describes the PAS procedures. It is noted that the conduct of a PAS is the responsibility of the cognizant contract administration office (DCAS, NAVPRO, etc.), although technical representatives of the purchasing office frequently participate in the actual survey.

3.2.3.1.2 Post-Award Conference

Though the rights and obligations of both parties are established by the terms of the contract, contractors do not always have a clear understanding of the scope of the contract for its technical requirements. Before performance begins, therefore, cognizant government personnel should take steps to satisfy themselves that the contractor fully understands every contractual provision. Whenever there is reason to believe that any misunderstanding exists, a post-award conference should be called to ensure that contractual requirements are discussed and that all differences between the parties are solved.

Such a conference should be a joint quality assurance, project management, planning, contract administration action as appropriate and conducted in accordance with DAR 1-803. The post-award conference results should be reviewed to ascertain the extent of quality assurance involvement and should be considered when performing quality planning for the particular contract.

Normally the contract administration office, after reviewing and analyzing the contract, will request such a conference; however, the contracting officer or his technical representative may also initiate the request. Regardless which office or government person initiates the request for a conference, it is vital that the conference be held as soon as possible after contract award.

Precautions should be taken in planning and conducting the conference. Nothing that takes place at the conference may change the contract unless a change(s) was planned and agreed to by the contracting officer prior to the conference.

In less complex contracts, a post-award letter to the contractor, rather than the formal conference, may be sufficient. When used, the letter should identify the contract administration representative and call attention to any unusual contract requirements (special reports, test data requirements, revised specification, government property to be furnished, etc.).

3.2.3.1.3 Product Oriented Survey

DAR Paragraph 14-202b provides that the purchasing office may conduct, in conjunction with the activity responsible for technical requirements, Product-Oriented Surveys and evaluations to determine the adequacy of the technical requirements relating to quality and product conformance to design intent. While the Product-Oriented Survey (POS) undoubtedly involves the simultaneous examination of various aspects of the contractor's inspection system or quality program, that should not be the objective of the survey. The sole intent of the POS should be to determine the adequacy of the product technical requirements relating to quality and to verify actual product conformance to the design intent. It is noted that NAVSEAINST 4855.26 "Product Quality Evaluations of Contractors; policies and procedures for" includes good guidelines for planning and conducting POSs. These guidelines could be effectively applied to any SYSCOM's POS. While the purchasing office, under DAR, has the authority to initiate and conduct POSs, it is recommended that the responsible contract administration service (DCAS, NAVPRO, etc.), be encouraged to actively participate. This participation can be particularly important if it becomes apparent later that a complete Quality System Review is required, as well (see Paragraph 3.2.3.1.4). The conduct of a Quality System Review is the contract administration office's responsibility. A general outline of the POS process is as follows:

a. <u>Actions Prior to the Survey</u>

(1) Compile and review technical and contractual documentation

(2) Coordinate survey with cognizant DCAS office (or NAVPRO, etc.)

(3) Prepare schedule and agenda

(4) Establish survey team composition and select members

(5) Attempt to obtain related data concerning contractor (one source is NAVSEA data bank, NMQAO, Portsmouth Naval Shipyard, Portsmouth, New Hampshire, 03801)

(6) Coordinate survey with contractor

b. <u>Survey Actions</u>

(1) Conduct entrance meeting with contractor and DCAS

(2) Review manufacturing inspection and test areas

(3) Review inspection and test procedures

(4) Perform and/or witness product inspections and tests

(5) Keep contractor and DCAS informed as to findings

c. Actions Following the Survey

(1) Conduct exit meeting with contractor and DCAS

(2) Issue report of findings and recommendations (where appropriate)

(3) Assign corrective action follow-up responsibilities

3.2.3.1.4 Quality System Review

The Quality System Review (QSR) is conducted to determine the adequacy of a contractor's documented inspection system/quality program (IS/QP) and to determine the effectiveness of compliance with the IS/QP in controlling product quality. The QSR will include sufficient verification of selected IS/QP elements to gage the effectiveness of the contractor's production inspection. The QSR also includes a review of the DCAS QAR's in-plant Procurement Quality Assurance (PQA) program. The conduct of a QSR is the responsibility of the cognizant DCAS or other cognizant contract administration office. Often when it has been determined by the purchasing office that a quality survey should be conducted, it is better to have the purchasing office's technical agent participate in a jointly conducted QSR than to have the purchasing office conduct an independent Product-Oriented Survey which necessarily is narrower in scope. Joint DCAS/purchasing office (technical agent, conducted QSRs are encouraged whenever the scope of the survey is likely to exceed that appropriate to the Product-Oriented Survey. The Defense Logistics Agency Manual, DLAM 8200.3, describes the QSR process in detail.

*3.2.3.2 On-Site Surveys of Subcontractor Operations

The contractor shall schedule and conduct on-site surveys of subcontractor operations when necessary to assure compliance with product assurance program requirements. The frequency and coverage of each survey shall be based upon criticality or complexity of items being procured, known problems or difficulties and quality history. The planned coverage of each survey shall be documented and include examination of product assurance program elements, manufacturing operations and processes, products and documentation to determine compliance with established requirements. Results of surveys with recommendations for corrective action shall be documented and follow-up performed to assure satisfactory action.

3.2.4 QUALITY ASSURANCE REQUIREMENTS TO BE INCLUDED IN PROCUREMENT/ PURCHASE DOCUMENTS

In addition to describing the specific development or fabrication requirements which are the object of the procurement, the purchase document or

*Suitable for direct inclusion in a contract Statement of Work

requisition should prescribe the applicable quality assurance program or inspection system requirements to be imposed on the contractor (see Paragraph 3.1.17). The specific quality (or other product assurance requirements - see Table 3.5) to be imposed should be based upon the type and scope of the procurement. Aside from the basic consideration as to whether MIL-I-45208A (Inspection System Requirements) or MIL-Q-9858A (Quality Program Requirements) is specified in the procurement, the following quality assurance provisions also should be considered and, if applicable, appropriate requirements established:

a. Government inspection/acceptance responsibility?

(1) NOSC project office

(2) NOSC Code 9312

(3) DCAS representative

(4) Joint NOSC/DCAS

b. Location of inspection?

(1) At source (contractor's plant)

(2) At destination (NOSC or other destination)

c. Location of acceptance?

(1) At source

(2) At destination

d. Pre-award survey requirement?

(1) By NOSC

(2) By DCAS

(3) Joint NOSC/DCAS

e. Post-award survey requirement?

(1) By NOSC

(2) By DCAS

(3) Joint NOSC/DCAS

f. Inspection system (MIL-I-45208)/QA program (MIL-Q-9858) plan required?

(1) To be reviewed/approved by NOSC

(2) To be reviewed/approved by DCAS

g. Inspection/Test Procedures Required?

(1) To be reviewed/approved by NOSC

(2) To be reviewed/approved by DCAS

h. First article units or preproduction sample requirement?

(1) Number of units and type

(2) Inspection/testing requirements

i. Periodic production samples requirement?

(1) Specify lot size

(2) Specify sample size/sample plan

j. Production units inspection/testing requirement?

(1) 100 percent inspection

(2) Sample inspection (see Appendix L)

(a) MIL-STD-105 sample plan

1 Reduced, normal or tightened inspection

2 AQLs

a For critical characteristics (recommend 100%)

b For major characteristics (see Appendix L)

c For minor characteristics (see Appendix L)

d For unclassified characteristics (see Appendix L)

3 Are characteristics to be considered on an individual or a collective basis (see Appendix L)?

(b) Other sample plan

(3) Test requirements

k. Contractor monitoring/surveillance?

(1) NOSC project office

(2) NOSC Code 9312

(3) DCAS representative

l. Configuration control requirement?

(1) Configuration control standard

(a) DOD-STD-480

(b) DOD-STD-481

(2) Change approval authority for engineering change proposals (ECPs), waivers/deviations (W/Ds) (see Paragraph 3.1.12.2)

(a) ECPs (NOSC project office)

1 Class 1 ECPs

2 Class 2 ECPs

(b) W/Ds

1 Critical/major W/Ds

2 Minor W/Ds

Additional guidance to assist in determining appropriate requirements for procurements may be found in:

a. "Guide for the Identification and Preparation of Procurement Packages Involving Technical Data and Product Assurance Requirements," available from the Product Assurance Division, Code 931

b. NOSCINST 4200.5 "Procurement Requirements Package (PRP) Handbook" or its successor document

c. Summary of Procurement Quality Assurance Requirements of Defense Acquisition Regulation (DAR), Section XIV, included as Appendix C

3.2.5 PROCUREMENT/PURCHASE DOCUMENT PROVISIONS

Including appropriate basic technical requirements in NOSC or contractor initiated requisitions or other purchase documents is essential to ensure that procured components or equipment will function or perform as intended.

*3.2.5.1 Basic Technical Requirements To Be Included in Procurement/Purchase Documents

Purchase documents shall include the following as applicable:

a. Applicable drawings, specifications, test and inspection requirements and procedures; process specifications or procedures; special test and inspection equipment requirements

*Suitable for direct inclusion in a contract Statement of Work

b. Specifications for identification and preservation and packaging requirements

c. Requirements for the subcontractor to notify the contractor of any proposed changes to approved design, products, materials, fabrication methods or processes and to obtain approval prior to incorporating changes

d. Requirements for the subcontractor to notify the contractor of changes to the design, materials, fabrication methods or processes for functionally disclosed products (i.e., "black box" or proprietary products) that were qualified by the subcontractor

e. Detailed provisions, as appropriate, regarding the performance of inspections, maintenance of test and inspection records and submittal of data

*3.2.5.2 Procurement/Purchase Document Detailed Provisions

In addition to the basic technical requirements (see Paragraph 3.2.5.1) the following statements or equivalents shall be included in the contractor's purchase document as applicable:

a. Government Inspection. When government inspection is required, include: Government inspection is required prior to shipment from your plant. Upon receipt of this order promptly notify the government representative who normally services your plant so that appropriate planning for government inspection can be accomplished.

b. Contractor Source Inspection. When contractor source inspection is to be utilized, the procurement document shall so indicate.

c. Subcontractor Product Assurance Program Review. The government procuring activity and the (name of contractor) reserve the right to review the (name of subcontractor) facilities and operations to determine compliance with applicable product assurance requirements.

d. Raw Materials. Chemical and physical test results shall be submitted. Purchased raw materials which are required to satisfy documented specifications shall be accompanied by a detailed analysis report.

e. Raw Materials Used in Purchased Articles. The subcontractor shall maintain for a period of four years the records of detailed results of chemical and physical analyses of acceptance test results on raw materials that are required to satisfy specification requirements employed in the manufacture of articles purchased on this contract/purchase order.

f. Inspections Performed. Evidence of specific tests or inspections shall be provided to the (name of contractor). Inspection records shall be maintained by (name of subcontractor) and be adequate to ascertain the quality level of production processes for a period of four years.

*Suitable for direct inclusion in a contract Statement of Work

g. Limited-Life Items. Products determined to have characteristics susceptible to quality degradation with age or storage environment shall be marked to indicate the date at which the useful life was initiated or will be expended.

h. Resubmission of Rejected Material. Products rejected by (name of contractor) and subsequently resubmitted by (name of subcontractor) shall bear an adequate indication of such resubmission on those products or on the shipping document. Reference shall be made to the (name of contractor) rejection document and evidence given that the causes for rejection have been corrected.

3.2.6 PROCUREMENT/PURCHASE REVIEW

It is an established practice at NOSC to require independent product assurance organization review of procurement/purchase documents for the inclusion of appropriate product assurance requirements. It is also an established practice to include contractual provisions requiring independent product assurance review of the contractor's own procurement documents.

*3.2.6.1 Procurement/Purchase Document Review

The contractor shall establish and maintain a system that provides for independent product assurance organization review of procurement/purchase documents to ensure that adequate requirements are included or referenced. This system shall ensure that:

a. Basic technical requirements have been included

b. Appropriate product assurance program or inspection system requirements have been specified

c. Applicable documentation and data requirements have been included

d. The subcontractor is an approved source or is to be evaluated in accordance with the procurement source selection requirements (see Paragraph 3.2.1)

e. Applicable qualification test requirements are specified (see Paragraphs 3.3.1.2 and 3.4.4)

f. Provisions are made for extending procurement requirements to lower-tier subcontractors and suppliers

Procurement/purchase documents and reference data shall be made available to the government representative for review to determine compliance with contract requirements and the need for government inspection at the subcontractor facilities.

---

*Suitable for direct inclusion in a contract Statement of Work

3.2.7 PROCUREMENT/PURCHASE DOCUMENT CHANGE CONTROL

NOSC's procurement practices generally provide for good control of changes to procurement/purchase documents (i.e., requisitions). An equivalent requirement is appropriate for inclusion in major contracts.

*3.2.7.1 Procurement/Purchase Document Change Control

The contractor shall establish and maintain a system for the control and approval of changes to the basic technical requirements of procurements. Such basic requirements may include those expressed by engineering drawings, material and process specifications, assembly or calibration procedures, performance specifications, inspection or testing requirements and procedures, etc. For products being procured to the contractor's own design, the control shall include assurance of otification of the subcontractor regarding the change, verification of the incorporation of the change by the subcontractor and appropriate identification of those items in which the change is incorporated. When subcontractor design, fabrication methods or processes have been approved or qualified by the contractor, controls shall be established to assure that the subcontractor provides written notice of proposed changes and obtains contractor approval prior to the incorporation of any change.

3.2.8 GOVERNMENT/CONTRACTOR/SUBCONTRACTOR COORDINATION AND CORRECTIVE ACTION

Coordination and communication between the contractor and his subcontractors is essential.

*3.2.8.1 Contractor/Subcontractor Coordination and Corrective Action

Coordination shall be established with subcontractors to provide technical assistance and mutual resolution of product assurance problems and to assure compatibility of tests and inspections performed by the contractor and subcontractors. Results of tests and inspections from receiving inspection, in-process inspection, acceptance testing, shipping, installation inspection and operation shall be reviewed to identify problem areas and adverse trends. The contractor shall provide subcontractors with pertinent information and data concerning failures and deficiencies found with the subcontractor's product. When corrective action is required, the contractor shall ensure that the subcontractor takes prompt action to correct the deficiency and to prevent recurrence. The contractor shall follow up to evaluate and ensure that the corrective action taken is adequate and effective.

---

*Suitable for direct inclusion in a contract Statement of Work

3.2.9 GOVERNMENT/CONTRACTOR SOURCE INSPECTION

Government (DCAS or NOSC Code 9312) source inspection of products at the contractor's facilities or contractor source inspection of products at a subcontractor's facilities may be appropriate when one of the following conditions applies:

a. Products are being procured at a level of assembly which prevents verifying the quality by examination or test of the completed product at the delivery destination

b. Destructive tests are necessary at the contractor/subcontractor facilities

c. Special testing and inspection equipment and environments required cannot be reproduced feasibly and economically or made available at destination

d. Shipments of completed items are made to destinations other than to the procuring activity

e. Quality verification is more cost effective when conducted at the source

*3.2.9.1 Government Source Inspection

The government reserves the right to inspect, at the source, products produced or services performed at the contractor's/subcontractor's facilities. Government source inspection of products, when performed at subcontractor's facilities, ordinarily shall neither constitute acceptance of those products nor in any way release the contractor from his responsibilities for assuring the quality of those products. However, when direct shipments from the subcontractor's facilities are specified in the contract, government acceptance may be performed at the subcontractor's facilities. Unless the contract stipulates otherwise, government source inspection and acceptance must be authorized by the government DCAS representative, who is cognizant of the contract.

*3.2.9.2 Contractor Source Inspection

The contractor shall conduct source inspection of subcontractor products as may be necessary to ensure that the subcontractor conforms to the applicable drawings and specifications.

---

*Suitable for direct inclusion in a contract Statement of Work

3.3 DEVELOPMENT

The requirements in this section intend to invoke an approach to product assurance during the development process which focuses less on measured versus specified values and more on the engineering disciplines and controls by which product quality, considered in the very broadest sense, is attained. This approach attempts to take maximum advantage of existing NOSC or contractor engineering policies and practices, management procedures and controls and corporate experience and memory. While dealing principally with the development process, portions of the contents of this section may have application to production as well.

As with the balance of this document, it is stressed that not all the requirements of this section will apply to all projects and those that are applicable may require tailoring or modification.

3.3.1 DESIGN ASSURANCE

The mission/system analysis is an important first step in the development process and one which directly results in generating the system/equipment reliability, maintainability and logistics support requirements. Following this, the design analysis process is initiated and design practices guidelines and materials and parts selection guidelines are established. Once the design effort has begun, the design reviews are scheduled, thereby providing visibility of the development process.

*3.3.1.1 Mission/System Analysis

A mission profile shall be developed and documented to provide a time-phased description of the events and environments the system experiences from initiation to completion of a specified mission, including the criteria of mission success or mission failure. The mission phase and combination of environments (including transportation, maintenance and storage environments) that impose the most severe design constraints shall be identified. An analysis of the mission profile shall result in generating qualitative and quantitative factors for reliability, maintainability, availability, human factors, safety and quality for inclusion in the development specifications and to serve as standards for design evaluation. The mission/system analysis shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval.

*3.3.1.2 Design Analysis

As a part of the design process, analyses and design studies shall be performed to identify, quantify and qualify product characteristics in terms of attributes, tolerances and the test and inspection requirements necessary

*Suitable for direct inclusion in a contract Statement of Work

to produce a quality product. These analyses and design studies shall include the following:

a. Parameter studies that establish test attributes, allocate tolerances and record performance capabilities required for mission success and provide preliminary inputs to system, subsystem and equipment specifications and test and inspection requirements. Mission operational conditions, effect of system aging and test equipment in use at each level of fleet maintenance must be weighed in defining the proper tolerances and attributes to be controlled during production.

b. Items other than those of the contractor that are integrated into a system, such as government furnished equipment (GFE) for example. The contractor shall request parameter values from the procuring activity and shall use these values in the design analysis process. If the provided parameter values are incompatible or analysis indicates that the system will not meet specification requirements based on these parameter values, the contractor shall identify the problem areas, advise the procuring activity and propose alternate courses of action.

c. Identifying and classifying those characteristics of each equipment item that are essential to mission success.

d. Sneak circuit analysis on selected circuits. This analysis shall investigate sneak paths and other conditions that may exist in the design. Latent paths that degrade system performance below specification requirements shall be corrected.

e. Failure modes, effects and criticality analysis (FMECA) to identify failures that degrade system capability. The procedures of MIL-STD-1629 (SHIPS) or a procuring activity approved alternate procedure shall be used for performing a FMECA. The FMECA provides the disciplined method for proceeding through the system to assess failure consequences. The results of this analysis shall provide a basis for design improvement. Common mode and single point failure analyses shall be performed in conjunction with the FMECA, as appropriate. The FMECA shall be conducted in consonance with the contractor's reliability program.

f. Stress analysis of parts and materials (electrical, mechanical and thermal) for compliance with the applicable derating criteria, maximum design constraints and thermal limits.

g. Worst case analysis including an examination of component tolerances, parasitic parameters (inductance, capacitance, etc.), variations in input signal characteristics, circuit mode parameters and overall circuit characteristics (rise-times, power dissipation, impedance matching, etc.).

h. Reliability and maintainability analysis to provide data for use in assisting the logistics support analysis effort. The pertinent outputs shall include:

(1) The allocated and/or predicted mean-time-to-repair (MTTR) for each maintenance operation

(2) An evaluation of the adequacy of the qualitative maintainability design parameters and a statement of the qualitative requirements for each component of the system under analysis

(3) The maintenance concept for each system component

(4) The mean-time-between-failures (MTBF) and mean-time-between-maintenance-action (MTBMA) for each system component

i. Logistics analysis to define and quantify the resources required for maintaining the product. Analysis outputs shall include:

(1) The maintenance level delineation of specific maintenance tasks necessary to keep the equipment in, or return it to, operating condition

(2) Task times and frequencies

(3) Personnel requirements (skill levels and quantities)

(4) Training and training equipment requirements

(5) Support and test equipment, spares, repair parts and consumables

(6) Facility requirements

(7) Technical data requirements

j. Producibility analysis to identify actual or potential producibility problem areas.

3.3.1.3 Design Practices

The establishment and documentation of those practices to be followed in equipment design are recommended whether the design is to be accomplished inhouse or under contract. If the design is to be accomplished under contract, the development specification is an appropriate vehicle to invoke the general design practices requirements (see Paragraph 3.1.12.1). In addition to specifying the general design practices requirements in the development specification, it also is appropriate to require the contractor to expand on these general requirements and establish and document what his specific, detailed design practices will be (see Paragraph 3.1.15.1.9). Refer to NOSC TD 250 "Suggestions for Designers of Navy Electronic Equipment."

*3.3.1.3.1 Design Practices and Documentation

The contractor shall control design practices and documentation to assure that performance, quality assurance, reliability, maintainability, producibility, safety and human engineering requirements are incorporated in a consistent and uniform manner. The contractor shall use existing government standards, manuals and documentation insofar as practicable or as specified in

*Suitable for direct inclusion in a contract Statement of Work

the contract, supplementing these as necessary to meet contract requirements. To promote uniform and timely application of design standards, an index of these standards and guides shall be prepared prior to the initiation of detailed design and provided to design personnel. The index shall be maintained throughout the life of the project and shall include standards and guides for:

a. Parts selection, application and standardization

b. Assuring producibility, repairability and inspectability

c. Considerations of special tooling and special test equipment

d. Design practices for the enhancement of the reliability, maintainability, safety and human engineering aspects of the system/equipment

e. Tolerancing

f. Maintenance engineering

g. Environmental and cleanliness control for production and subsequent storage and maintenance

h. Selection of test points

i. Selection, application, standardization and specification production process

j. Packaging, storage and handling

k. Heat generation limits, dissipation and control

l. Providing protection for the system/equipment against harmful conditions encountered during manufacture, test and usage (i.e., electrostatic discharge, human induced contamination)

m. Computer programming techniques

n. Electrical grounding, bonding and shielding

o. Derating criteria

3.3.1.4 Parts and Materials Selection

The proper selection of parts and materials is crucial to ensure reliability is designed into equipment and is not just left to chance. The parts and materials selection, control and identification program described in the following is intended to apply discipline to this process by requiring the contractor to develop a Program Parts Selection List (PPSL) based on a number of guiding factors. A key factor is the establishment of minimum quality requirements for electronic components including passive components (resistors, capacitors, etc.), discrete semiconductor devices (transistors, diodes) and microcircuits. The requirements established in the following for these electronic components reflect NAVSEA's policy guideline (NAVSEA 096T-LP-597-1011) for

Navy electronic equipment design. Another key factor is the requirement to establish an electronic component derating policy for the design and to require verification of that policy. Finally, to provide the required control, the contractor is required to submit nonstandard parts requests whenever he anticipates the need to deviate from the approved PPSL.

The critical elements of a good parts and materials selection and control program are included in Section "a" of Paragraph 3.3.1.4.1 and are considered to be essential for an equipment design/development project in the Full-Scale Development Phase. Sections "b" and "c" add identification and information collection requirements which are considered to be optional depending on the complexity of the system.

***3.3.1.4.1 Parts and Materials Selection, Control and Identification Program**

The contractor shall establish a parts and materials selection, control and identification program including the following:

a. The parts and materials selection and control segment of the program shall provide for:

(1) Establishment of a parts control program meeting the requirements of MIL-STD-965, Procedure I. The selection of parts to be utilized in the design shall be in accordance with a Navy approved Program Parts Selection List (PPSL) based on suitable application and qualification to specified requirements using available reliability data. The order for selection of standards and specifications for parts and materials shall be in accordance with MIL-STD-143, with full consideration of the specified performance, qualification, reliability, safety and configuration management requirements. As a minimum, passive electronic components shall be selected from Established Reliability (ER) military specifications and shall have an ER failure rate of "P" or better (i.e., R, S or T). Additionally, discrete semiconductors shall be MIL-S-19500 level "JANTX" or better (i.e., JANTXV or JANS) and microcircuits shall be MIL-M-38510 Class "B" or better (i.e., S). Standard electronic modules, in accordance with MIL-STD-1378, shall be used in all new design applications.

The PPSL shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval. Parts not included in the PPSL may not be used without specific Navy approval of a nonstandard parts request prepared in accordance with CDRL item number (specify).

(2) Maximum use of previously qualified parts and materials

(3) Establishment of a parts derating policy meeting the requirements of NAVSEA 0967-LP-597-1011 and the performance of circuit element stress analysis to verify compliance with that derating policy

*Suitable for direct inclusion in a contract Statement of Work

(4) Adequate testing requirements with inclusion of appropriate inspection and testing requirements on the engineering drawings. Particular attention regarding the inclusion of inspection and testing requirements should be given to those drawings describing parts anticipated to be procured as spare or repair parts.

(5) Minimization of the total types and numbers of parts and materials

(6) Minimum use of limited-life items

(7) Selection of parts and materials which will be readily available as long-term supply items

(8) Exclusion of toxic materials, except when specifically approved by the procuring activity

(9) Consideration of transportation, handling, storage and installation limitations

(10) Availability of multiple procurement sources

(11) Product producibility

b. A complete parts and materials identification and status list including all PPSL items shall be developed, prior to initiation of detailed design, for use in parts and materials selection. The list, which shall be maintained and updated throughout the development phase, shall contain the following:

(1) Item identification by generic name, government and subcontractor part numbers, national stock number where applicable or a government or industry standard in the case of a material or process

(2) Qualification status, including how qualified (e.g., test, analysis, established reliability part)

(3) Identification of standard parts (authorized for use by Navy approval of the PPSL) and identification of nonstandard parts showing specific Navy authorization for nonstandard parts use

(4) Identification of limited-life items

(5) Identification of subcontractors as recommended by the designer for possible inclusion on the approved source list

(6) Identification of proprietary and sole-source parts and materials

c. A system shall be established and maintained for collecting and disseminating information such as:

(1) Approved circuits

(2) Approved parts lists

(3) Results of products qualification and engineering tests

(4) Reliability reports regarding usage and failure rates

This information shall be readily accessible to the design engineers and must be current, concise and accurate.

*3.3.1.5 Key Components

A system shall be established and maintained to determine, identify and control key components. Key components are the limited number of critical parts whose failure in operation would most probably be catastrophic to the system performance and which, because of their past history, have a deficiency potential that warrants strict processing control and traceability. A list of key components shall be developed and maintained for review by the procuring activity. The system shall provide for:

a. Determining the need for and level of traceability required

b. Strict processing and handling controls

c. Identifying each individual component

*3.3.1.6 Control of Key Components

Key components (see Paragraph 3.3.1.5) require strict processing control by the contractor and the contractor must maintain control of these components regardless of their location. When a key component is purchased, the supplier shall submit the following information to the contractor for review:

a. Procedures for control of processes to be used (subject to limitations imposed because of proprietary information)

b. The location within the processing cycle where inspections and tests will take place

c. The attributes of the components which will be inspected at each inspection point

d. The materials and methods of preservation and packaging to be used to protect the components

e. The handling and transportation precautions necessary to protect the components

Revising or varying any of the above listed controls shall not take place until the contractor has accepted the revision.

---

*Suitable for direct inclusion in a contract Statement of Work

3.3.1.7 Design Review

Program design reviews are essential to ensure that the project design objectives and the product assurance objectives of reliability (see Paragraph 3.1.15.1.10), maintainability, availability, quality and safety will be met. NAVMATINST 3000.1A (Reliability of Naval Material) requires such reviews be conducted, as does NOSCINST 4855.1 (NOSC Product Assurance Program). Generally, design reviews are of two types, informal and formal. Informal reviews are conducted at frequent intervals on a scheduled basis and, when conducted by a development contractor, may or may not involve Navy project office personnel. A recommended contractual requirement for informal (internal) design reviews is provided in Paragraph 3.3.1.7.3. Formal design reviews, where the NOSC project office and usually the SYSCOM sponsor participate, typically are held two or three times during the course of the program. The minimum formal reviews, which must be specified as required to meet the specific program needs, would include a preliminary design review (PDR) and a critical design review (CDR), although intermediate reviews may be scheduled as well. The PDR and CDR are defined as follows.

3.3.1.7.1 Preliminary Design Review (PDR)

This is a formal technical review of the basic design approach for developing the system and is held after the design approach has been established but prior to the start of detailed design. In general, the purpose of the PDR is to evaluate progress, technical adequacy and risk resolution and to assure the government the design approach appears adequate to meet the contract specification requirements and detailed design can commence. All major trade-off studies should have been completed prior to PDR and all major technical issues for both hardware and computer software should have been resolved by the completion of PDR. DOD-D-1000, Level I engineering drawings are appropriate for depicting the design concept and these should be available for review by the project office a minimum of 10 days prior to PDR. The computer software program performance specification (PPS) and the interface design specification (IDS) must be baselined at the PDR. See Appendix C to MIL-STD-1521 for a detailed description of PDR. When tailored to the specific program needs, the MIL-STD-1521 Appendix C requirements could be specified as a contractual requirement for PDR.

3.3.1.7.2 Critical Design Review (CDR)

This is a formal technical review held when the detailed design is substantially complete to determine that the design satisfies the performance and engineering requirements of the contract specification. At the time of CDR, the majority (50 to 60 percent) of the engineering drawings should have been completed and the computer software program design specification should have been approved. See Appendix D to MIL-STD-1521 for a detailed description of CDR. When tailored to the specific program needs, the MIL-STD-1521 Appendix D requirements could be specified as a contractual requirement for CDR.

With many projects, one or more intermediate design reviews are held between PDR and CDR. Where the development is being performed under contract, provisions for both formal and informal (internal) design reviews by the contractor should be included.

*3.3.1.7.3 **Internal Design Review**

Contractor internal design reviews shall be performed to evaluate pertinent aspects of the design and to assure that the necessary related requirements are included in the design documentation. The planning, scheduling and procedures to be followed in the performance of design reviews shall be documented. Design reviews shall be performed by specialists (other than those performing the original design) who are familiar with the technical disciplines of design such as: parts application, reliability, maintainability, human engineering, safety, quality, production, programming and manufacturing procedures as required. The reviews shall be performed on a planned basis as new design documents and changes are generated and at major product design milestones. Advance notification of design reviews, including agenda items and certified data packages sufficient to evaluate the design adequacy, shall be provided to participants. The result of each design review and subsequent actions shall be documented to include:

a. A list of documentation reviewed, decisions reached and design review participants

b. Identification of inadequacies, recommendations for corrective actions and assigned responsibilities

c. Actions taken to correct design deficiencies

The contractor shall monitor the status of all action items resulting from design reviews and assure their timely resolution. Design reviews and required actions shall be completed before approval of design documentation.

3.3.2 **INTEGRATED TEST PROGRAM**

An integrated test program (ITP) should be established early in development and maintained to include planning and performance of all tests to be conducted during each life cycle phase.

The purpose of the ITP is to ensure that all tests contribute to the achievement and verification of product requirements without overlap or void and within the general program goals of schedule and minimum cost. The integrated test program should provide for maximum use of all test results to identify and correct potential quality problems as early as possible and to assess the achieved reliability. ITP program policy, organizational responsibility and implementing procedures should provide for:

a. Establishing a positive management system for effective use and control of all test resources

b. Establishing and evaluating integrated test program objectives, plans and schedules including requirements for test documentation, facilities, equipment, samples and acceptance criteria.

---

*Suitable for direct inclusion in a contract Statement of Work

c. Establishing uniform requirements, guidelines and instructions for use in test planning

d. Reviewing specifications and approval of test procedures

e. Monitoring testing activities and problem solutions

f. Technical reviewing and approval of test results

g. Incorporating test data into the integrated data system

h. Reporting program progress

*3.3.2.1 Integrated Test Program Plan

An integrated test program plan (Master Test Plan) shall be prepared and submitted for government approval, as required by CDRL item number (specify). The plan shall describe those tests planned to be conducted during the performance of the contract which are expected to contribute to the achievement and verification of the product requirements. The plan shall:

a. Describe the organization and management of the integrated test program

b. Include a summary of all pertinent tests to be conducted during each phase of development including the item to be tested, the type of test and the test objectives

c. Identify those tests which will be used to evaluate reliability and maintainability

d. Define the outputs of the ITP that contribute to production test planning as required to define test requirements applicable to production

e. Define the ITP outputs that contribute to the preparation of field and deployment test planning

f. Include schedules for test and test documentation showing major program milestones needed to evaluate the program

g. Define and describe reporting requirements

*3.3.2.2 Test Documentation

a. Test Plans. Individual test plans shall be prepared for tests conducted during the design and development program. Each plan shall include:

(1) Identification of products and quantity to be tested

(2) Test objectives

---

*Suitable for direct inclusion in a contract Statement of Work

(3) Test requirements (i.e., test parameters, environments, test time, facilities and measurement equipment requirements)

(4) Accept/reject criteria

(5) Data collection, analysis and reporting requirements

(6) Safety precautions

b. Test Procedures. Test procedures shall be prepared and submitted for government approval as required by CDRL item number (specify) for all engineering evaluation and qualification tests and for development tests intended to verify design capability. Test procedures shall include:

(1) Characteristics to be measured, defined in terms of conditions which should exist during test, tolerances and levels or limits of inputs

(2) Test set-up showing stimulus equipment, fixtures and measurement and recording instrumentation

(3) Environmental and special equipment or facilities

(4) Method to be used in test performance, including sequential steps; military standard test methods shall be used when applicable

(5) Verification and prerequisites to be made before conduct of tests

(6) Description of the acceptance criteria

(7) Instructions for data recording, technical evaluation and reporting

(8) Applicable safety precautions for personnel and facility protection

(9) Criteria for continuation/discontinuation of tests after failures or repairs of test items or test equipment

3.3.3 ENGINEERING DEVELOPMENT TESTS

Engineering development tests provide data to support the design effort and provide assurance that the design configuration meets specification requirements. The engineering test program (i.e., development, engineering evaluation and qualification tests) should be structured to include a reasonable assessment of the product's reliability to confidently approach the reliability demonstration testing effort. The reliability and maintainability demonstration tests (see Paragraphs 3.1.15.1.7 and 3.1.15.2.7) typically are performed following the completion of the qualification tests (Paragraph 3.3.3.3) and when the analysis of the test data indicates that the specified reliability and maintainability requirements can be achieved. Engineering development tests should be performed according to documented test plans and

procedures prepared in accordance with the integrated test program requirements (see Paragraph 3.3.2). Test data, including test conditions, significant events and problems, should be recorded and maintained for all tests. These include:

*3.3.3.1 Development Tests

As a part of the design function, development tests shall be performed on models, breadboard circuits, components or other items to establish basic design parameters and determine functional capabilities.

*3.3.3.2 Engineering Evaluation Tests

Engineering evaluation tests shall be performed to:

a. Assess the degree to which the design, parts and materials meet design objectives

b. Determine the effects of varying stress levels or combinations and sequence of environments

c. Identify failure modes and effects

d. Estimate system/equipment reliability, maintainability and operating life

e. Verify safety requirements have been met

f. Identify human factors problems

Engineering evaluation tests shall be performed at the highest assembly levels practicable, preferably on prototype and preproduction items which closely represent the expected production configuration.

*3.3.3.3 Qualification Tests

Qualification tests shall be performed on items to demonstrate that design specifications have been met. Qualification tests shall be conducted to the environmental extremes demanded by the mission profile and shall involve the most severe levels, combinations and sequences of functional stress from design specifications. The qualification test program shall be so structured that, upon completion, there will be little risk of the item failing any reliability demonstration testing and not being certified. This requires that the qualification test results give a positive indication of the reliability of the product when considered in combination with all other test time and associated problems, failure of corrective actions and defined risk of recurrence and impact of configuration status at production release on previously conducted qualification testing. Qualification tests shall be performed at the highest level practicable on samples closely representing the intended production

---

*Suitable for direct inclusion in a contract Statement of Work

configuration (i.e., manufactured to the proposed production drawings and inspected and tested to the proposed production acceptance procedures). Design changes made to correct performance or reliability deficiencies subsequent to item qualification tests shall be requalified by tests equal to the original qualification tests, if portions of the original tests are invalidated. Qualification tests on items procured from different subcontractors shall include samples from every source of each different design configuration. When a family of items is being qualified, the qualification test specimens shall include a sampling of the range of values being considered to satisfy design requirements. Contractor personnel shall verify the adequacy of qualification tests conducted at locations other than the contractor facilities and based on witnessing the tests or on examining certified records. The qualification test program plan shall be documented as specified in contract data requirements list (CDRL) item number (specify) and shall be submitted for Navy approval.

*3.3.3.4 Test Reports

Test data including test conditions, significant events and problems shall be recorded and maintained for all tests. Test reports shall be prepared for: development tests intended to verify design capability, engineering evaluation tests and qualification tests. These reports shall describe the results of test data analysis, conclusions and recommendations. These test reports shall be documented and submitted in accordance with CDRL item number (specify).

3.3.4 TEST AND INSPECTION DURING DEVELOPMENT

Test and inspection during development should be an evolutionary process which becomes more controlled and more specific as the item design matures.

*3.3.4.1 Test And Inspection of Hardware During The Validation Phase

Test and inspection of validation or advanced development phase hardware (i.e., prior to establishment of a configuration allocated baseline) shall be for the purpose of determining and recording critical parameters and the difference between the design as-tested and the design as-intended. The following guidelines are provided for these tests and inspections:

a. Where the required <u>limits for proper functioning are not known precisely</u>, as in the case of new, unique or state-of-the-art devices or designs, inspection and material control shall be on a "variables" basis to the best accuracy reasonably attainable. All characteristics (i.e., dimensions, material composition and processes) shall be measured and the actual measured values shall be recorded.

b. Where the required <u>limits for proper functioning are known</u>, inspection and material control may be on an "attributes" basis (i.e., Go/No-Go).

---

*Suitable for direct inclusion in a contract Statement of Work

Data obtained during test and inspection shall be used to provide an information feedback for changes in design and manufacturing processes. This will permit items to be produced with minimum rejects and rework and make optimum use of available tolerances. Discrepancies found shall be reviewed and resolved by designated personnel. Test and inspection discrepancies and their resolutions shall be fully documented and maintained for use in establishing requirements for the full-scale development phase.

*3.3.4.2 Test and Inspection of Hardware During The Full-Scale Development Phase

During full-scale development, commencing with the establishment of the allocated baseline, all hardware test and inspection shall be performed using fully documented and controlled procedures. Receiving, in-process and final test and inspection shall be performed to determine compliance to engineering released drawings and specifications. Products which do not meet drawing and specification requirements shall be considered as nonconforming material and identified and rejected accordingly. Prior to being utilized further, all nonconforming material shall be subjected to engineering (including reliability) review and disposition.

*3.3.5 MATERIAL IDENTIFICATION AND HANDLING

The contractor shall establish and maintain a system for handling and identifying the intended use of material so that it will be controlled and used only as intended during development. Adequate methods shall be specified to identify, preserve, package, pack, handle and store products to preclude damage, deterioration or misuse. Requirements for special preservation, packaging, packing, handling and storage shall be specified during development so that procedures, containers and fixtures are available as required.

*3.3.6 MANUFACTURING CONTROL DURING DEVELOPMENT

Manufacturing processing and fabrication operations shall be accomplished under controlled conditions. Those conditions include documented work instructions, documented process control procedures and controlled production equipment and working environments. These instructions and procedures shall provide the criteria for performing the work functions and shall be compatible with acceptance criteria for workmanship. Through the use of process "travellers" the inspection status of products shall be clearly indicated throughout the manufacturing operations.

3.3.7 PRODUCIBILITY REVIEW

During the full-scale development phase, the design should be reviewed to identify those features of the design which require production methods or manufacturing controls which exceed normal industrial practices or capabilities. These features may be the result of unusual configurations, applications of difficult-to-process materials, close tolerances and finishes, or

---

*Suitable for direct inclusion in a contract Statement of Work

uses of sensitive, hazardous or other processes that indicate potential production yield problems. Where anticipated production quantities are extremely large and time permits, a pilot production program should be conducted to develop the required special manufacturing techniques and tooling and ensure that production yields will be satisfactory. (Also see Paragraph 3.4.1.)

Where the production units are expected to be produced under a competitively awarded contract or where repetitive future production, including significant spare parts, is anticipated, the "producibility analysis" requirement of Paragraph 3.3.7.1 may be appropriate. (Also see Paragraph 3.4.1.) Where the contract requires that the development contractor produce the production units and no follow-on production is anticipated, including significant spare parts, the "readiness for production review" requirement of Paragraph 3.3.7.2 may be appropriate.

*3.3.7.1 Producibility Analysis

The contractor shall perform a producibility analysis of the (name) system/equipment and shall submit a producibility analysis report, CDRL item number (specify), to identify those design features which require production methods or manufacturing controls exceeding normal industry capabilities or practices. In addition, the contractor should provide a detailed explanation of any experimental processing conducted in connection with the analysis. A statistical analysis of the variables data obtained from the experimental processing shall be included to show that the process is capable of providing an acceptable yield. Any unique process developed in connection with this analysis shall be documented in detail on an engineering drawing or other format specified by the procuring activity and shall be included as part of the (name) system design data package. A unique process is one which is not common to the industry.

*3.3.7.2 Readiness for Production Review

The contractor shall conduct readiness reviews prior to beginning the manufacture of production hardware. The readiness shall assess the degree to which:

a. The development program has progressed toward readiness for production

b. Producibility problems encountered during development have been resolved

c. The plans, procedures, materials, facilities, procurement sources, test and measuring equipment, production equipment and tools, software and personnel resources required for the manufacture of production hardware are in place and have been demonstrated to be adequate and complete

Problems identified during the readiness review shall be documented and corrected.

---

*Suitable for direct inclusion in a contract Statement of Work

3.4. PRODUCTION

3.4 PRODUCTION

The requirements of this section and of Section 3.5 are applicable to production programs and selectively to full-scale development and pilot production, as well. (Also see Paragraph 3.4.2.)

As with the balance of this document, it is stressed that not all the requirements of this section will be applicable to all projects and those that are applicable may require tailoring or modification.

3.4.1 PRODUCTION DESIGN REVIEW

While it is expected that NOSC, through the Design Review Committee process, and NAVMAT, through the Defense System Acquisition Review Council (DSARC) process, generally will determine a system's production readiness, it is recommended that as his initial effort, the selected production contractor be required to perform an independent production design review. Such a review will help to ensure that the production documentation (drawings and specifications) are complete and well defined from the manufacturer's viewpoint. An early, detailed review of the development program and of the production documentation should help identify any essential engineering changes which could result in extensive additional costs and schedule delays, if discovered later. A prerequisite for such a review by the contractor would be a thorough briefing by the NOSC project office on the development program and, in particular, on the resolution of those performance problems encountered during operational testing. This review need not delay the contractor's efforts in other areas, such as ordering long-lead components or developing manufacturing procedures and tooling. This review is appropriate where a producibility analysis of the type described in Paragraph 3.3.7.1 had not been conducted during full-scale development.

*3.4.1.1 Review for Production Operations

After being briefed by the NOSC project office on the (name) system development effort, the contractor shall conduct a review of the production documentation (drawings, specifications, etc.) to verify its completeness and the clarity of its requirements. In addition to identifying any discrepancies existing in the documentation, the contractor shall identify any process or physical feature requirements which are anticipated to result in uneconomical or otherwise unacceptable production yields. At the conclusion of this review the contractor shall submit a report, meeting the requirements of CDRL item number (specify), and summarize the findings of the review and list any significant changes he recommends. ECPs are not to be prepared at this time. The contractor shall provide a rough-order-of-magnitude estimate of the cost savings which would accrue to the government on this contract, should such changes be incorporated. The contractor is advised that the government will have no obligation to accept any of such recommended changes, but should any be found acceptable to the government they would be incorporated in accordance with the configuration control procedures of the contract. In such instance,

---

*Suitable for direct inclusion in a contract Statement of Work

the government may choose to direct the contractor to prepare the necessary ECPs under the engineering services provision of the contract.

3.4.2 PRODUCT ASSURANCE PROGRAM FOR PRODUCTION

The product assurance requirements, principally, the quality assurance type, outlined in the subsequent paragraphs of this section and of Section 3.5, are directly applicable to the production phase although selected requirements may be applicable to full-scale development as well. <u>These requirements (i.e., Sections 3.4 and 3.5) taken in their entirety, together with applicable quality assurance type program management requirements of Section 3.1, are an integration and expansion of the fundamental quality assurance requirements of MIL-Q-9858 (quality program requirements) and MIL-STD-45662 (calibration program requirements)</u>. They may be used in lieu of or, on a selected basis, in conjunction with these specifications. (Also see Paragraph 3.1.17.)

*3.4.2.1 Production Product Assurance Program

The contractor's production product assurance program shall be established and maintained with necessary supporting documentation for all contractor produced and procured products to assure that applicable drawings, requirements and controls are maintained in the production process. The program and its application to all phases of production shall provide assurance that the quality, reliability, maintainability, producibility, human factors and safety inherent in the design as reflected in the engineering drawings and specifications are adequately translated into the finished product.

3.4.3 FABRICATION

*3.4.3.1 Parts and Materials Control

Controls shall be established and maintained to assure that:

a. Only acceptable parts and materials are released to fabrication operations and items excess to the operations are controlled to prevent misuse

b. Where kitting techniques are employed, accumulation of parts and materials for assembly or fabrication are complete and properly identified

c. Items determined to be susceptible to age or environmental degradation are identified with the proper control markings and relevant dates

d. Items are protected and controlled during storage, handling and manufacturing operations by:

(1) Providing proper environmental protection

(2) Preventing issue or use of items whose shelf life has expired

---

*Suitable for direct inclusion in a contract Statement of Work

(3) Purging items whose shelf life has expired

(4) Periodically inspecting stored items for deterioriation and damage

(5) Assuring the use of designated handling equipment

The product assurance organization shall conduct surveillance of parts and material storage and issue controls to assure that approved procedures are being followed and established controls are effective.

*3.4.3.2 Process Controls

Manufacturing processes shall be controlled, especially those where acceptable quality cannot readily be determined at final inspection. Manufacturing processes shall be evaluated to determine which process characteristics either influence or have an effect on the quality of the production item. These manufacturing processes and related equipment shall be identified and requirements for their control shall be specified in manufacturing process specifications. Process control procedures shall be developed as necessary to supplement process specifications. These procedures shall include: methods to verify periodically the adequacy of the processing materials, environments, solutions, equipment and their associated control parameters and recording the results of process verifications performed. The methods and procedures shall be reviewed by the product assurance organization which shall provide surveillance to assure that approved methods and procedures are followed.

*3.4.3.3 Assembly Operations

Fabrication and assembly operations shall be controlled to assure that characteristics and criteria specified in technical documents are achieved and maintained in the produced items. Detailed fabrication and assembly instructions shall be developed and used by personnel performing these operations. These instructions shall:

a. Identify the item

b. Identify equipment or tools required including special handling devices

c. Identify material and parts required including consumables

d. Reference instructions for performing the operation

e. Identify characteristics and tolerances to be controlled

f. Provide procedures for controlling special processes

g. List special conditions to be maintained, such as material protection, environmental conditions, safety controls and equipment maintenance

---

*Suitable for direct inclusion in a contract Statement of Work

h. Provide workmanship standards and manufacturing aids

i. Provide test and inspection points

j. Provide record guidance for indicating completion of each operation

k. List safety considerations

The product assurance organization, through continuing surveillance, shall assure that approved documented methods and procedures are followed and that environmental and cleanliness requirements and applicable workmanship standards are implemented and maintained.

***3.4.3.4 Environmental and Cleanliness Control**

The contractor shall provide adequate facilities for fabricating, assembling and testing products. Unless otherwise specified, the minimum standards for working environments delineated in MIL-STD-1695 shall apply.

***3.4.3.5 Workmanship Standards And Requirements**

Essential workmanship standards (i.e., item samples, visual aids, other clearly defined acceptance criteria) shall be developed to assist in manufacture and inspection. Conditions for acceptance and rejection shall be clearly depicted for characteristics requiring visual inspection. Unless otherwise specified in the contract or in the drawings and specifications, the general workmanship requirements of MIL-STD-454, requirement 9 and the soldering requirements of MIL-STD-454, requirement 5 will apply. Additionally, unless otherwise specified, printed wiring boards shall meet the requirements of MIL-P-55110.

***3.4.4 TEST AND INSPECTION PLANNING**

Plans and procedures shall be developed and maintained for tests and inspections to be conducted during the production phase. Test and inspection points shall be identified in production flow plans and implemented during manufacturing operations through identifying test and inspection points in production documentation (i.e., travelers, shop order, operations sheet, etc.). Sufficient examination points shall be specified to assure that the tests and inspections are conducted prior to work operations that preclude detecting and correcting deficiencies or result in excessive cost. The degree of tests or inspections shall be consistent with the criticality of the characteristic. The test and inspection plan shall be documented in accordance with CDRL item number (specify) and submitted for approval.

***3.4.5 QUALITY VERIFICATION**

Tests and inspections shall be conducted and data recorded in accordance with documented test and inspection procedures. Product assurance organization personnel shall perform the quality verification to determine compliance with contractual requirements.

---

*Suitable for direct inclusion in a contract Statement of Work

*3.4.5.1 Receiving Test and Inspection

A receiving test and inspection system shall be established and maintained and provide for the following:

a. Test and inspection of purchased items to verify compliance to specification and drawing requirements

b. Assurance that purchased items have been qualified when required

c. Evidence that required test and inspection have been performed and that required data have been provided

d. Verification that required test and inspection data are acceptable

e. Assurance that purchased items determined to be subject to age or environmental deterioration include proper control markings and relevant dates

f. Earliest practicable inspection of government-furnished material/equipment

g. Clear identification of item receipts so they may be readily recognized

h. Physical segregation of raw materials and purchased items which provide segregation of items awaiting test or inspection results, acceptable items and nonconforming items

i. Identification of purchased items, released from receiving inspection, to clearly indicate acceptance, nonconforming status or pending material review action.

*3.4.5.2 In-Process Test and Inspection

In-process test and inspection shall be performed during fabrication and assembly to verify the adequacy and control of the operations. Tests and inspections shall be performed at production points to minimize impact resulting from nonconformances. Tests and inspections shall be performed at or before the last point at which the acceptability of the item or characteristic may be completely verified. The test and inspection shall provide a measure of product and process quality and shall yield objective data for analysis and timely correction of adverse quality trends.

*3.4.5.3 Nondestructive Testing Processes

Controls shall be exercised over nondestructive testing processes (i.e., radiography, holography, infrared, ultrasonic, liquid penetrant, magnetic particle, eddy current). The adequacy of these processes shall be assured by standards, specifications, procedures, certification of personnel and equipment controls.

---

*Suitable for direct inclusion in a contract Statement of Work

*3.4.5.4 Configuration Verification

Configuration verification inspections shall be performed to verify that the as-built configuration of the product conforms to the released engineering documentation. Records shall be maintained that indicate inspections have been performed, changes have been incorporated as required and the as-built configuration has been compared to the as-designed configuration. Corrective actions shall be taken on all discrepancies noted during the inspection prior to acceptance of the product.

*3.4.5.5 Acceptance Test and Inspection

Acceptance test and inspection shall be performed on products to verify compliance with product specification requirements using procuring activity approved procedures. All such acceptance tests shall include a specific period of failure-free operation immediately prior to termination and acceptance of the test. In the event of failure, requisite corrective action shall be taken and the failure-free portion of the test reinitiated. (Consider the inclusion of this additional requirement — testing of electronic items also shall include random, pseudorandom or complex waveform vibration at 6g RMS or at qualification test levels, whichever is less, for 10 minutes in the axis deemed most susceptible to vibration excitation. Any failure shall require corrective action and test repetition.) The extent and quantity of such acceptance operations shall be sufficient to assure that the product conforms to specification requirements. Sampling test and inspection shall not be used in verifying performance characteristics for final acceptance of products unless approved by the procuring activity. The acceptance test and inspection procedures shall be documented in accordance with CDRL item number (specify) and submitted for government approval.

*3.4.5.6 Special Tests and Inspection

a. First article inspection. First article inspection (FAI) shall be performed on selected items (fabricated or purchased) which have significant impact on quality, schedule or cost. FAI shall be conducted on the first item of the production run and on the first items produced using new or modified manufacturing tooling or processes. FAI shall constitute a detailed inspection to verify manufacturing capability, proper use of materials and parts, process controls, product compliance to specified performance or other requirements and the validity of applicable documentation. Also, FAI shall be conducted on the first available sample of all purchased items procured to control drawings (i.e., specification control, source control or selected or altered item drawings); a list of all such items shall be provided in accordance with CDRL item number (specify) and submitted for government approval. The product assurance organization shall conduct or control FAIs and shall analyze the inspection data obtained. The product assurance organization shall then report the acceptability or nonacceptability of the first article sample along with any necessary fabrication/process changes. Where an item is designated for FAI, all characteristics of the first article sample shall be inspected and recorded.

---

*Suitable for direct inclusion in a contract Statement of Work

b. Qualification tests. Qualification tests to be performed during the production phase shall be performed in accordance with established criteria. These tests shall be performed on new items, items from new sources or plant relocation or when changes are made in materials or processes which affect previous qualification.

Personnel other than those responsible for qualifying the hardware shall witness the qualification tests and certify on the test documentation whether the items tested are acceptable or unacceptable. An item or a family of items determined to be unacceptable by the qualification test criteria established and documented in the test specification/procedure shall be identified clearly as nonconforming material. Disposition of this material shall be by material review action.

A First Article Qualification Test Plan, reflecting all first articles requiring testing to verify performance requirements, shall be documented in accordance with CDRL item number (specify) and submitted for government approval.

c. Periodic production tests. Periodic production tests shall be performed on a scheduled basis to verify that the required quality, reliability, maintainability and safety aspects of the product are maintained throughout production. The nature of the tests, environmental conditions and number of test samples selected for each assessment shall be compatible with the complexity of the production process and its controls. If an item is produced on more than one production line or procured from more than one source, sample selection shall cover all lines or sources. Determination of items to be tested shall be based upon:

(1) Susceptibility to environmental conditions

(2) Importance of application (affect on mission)

(3) Normal variability in production relative to specified tolerance

(4) Sensitivity to changes in processing variables

(5) Complexity of production process

(6) Population

Surveillance of the established periodic production test program shall be performed by the product assurance organization to assure that approved documented methods and procedures are followed, nonconforming items are identified and dispositioned in accordance with established procedures and appropriate corrective actions are identified and implemented in a timely manner.

*3.4.5.7 Inspection Indications

A system shall be established and maintained to indicate inspection status. The system shall include the following provisions:

a. The inspection status of items shall be clearly indicated throughout the entire production cycle. Documentation accompanying items (e.g., traveler, shop order, operations sheet) shall provide for indicating inspections performed and referring to inspection discrepancy reports generated.

b. Inspection stamps shall be used to indicate that inspections have been performed and that the item is accepted, nonconforming, or withheld-for-material-review status. Inspection acceptance identification shall be maintained with the item until incorporated into the next higher assembly. In the case of very small items or where stamping will compromise the quality, an inspection card, tag or other record shall be attached to the item or its container to indicate inspection status.

c. Inspection stamps shall be traceable to responsible individuals and records maintained to identify the individuals with specific stamps.

d. Stamps shall be of a design distinctly different from government inspection stamps.

*3.4.5.8 Test and Inspection Records

Records of tests and inspections performed shall be prepared and maintained. The records shall be appropriate for the type, scope and importance of the test or inspection performed and shall provide sufficient detail to provide objective evidence of extent of conformance to requirements and to permit necessary analysis for further action. Records shall cover aspects such as:

a. Inspection status of items

b. Traceability

c. Evidence of performance of required test and inspection

d. Extent of nonconformance

e. Disposition made of nonconforming items

f. Responsiblity for corrective action

g. Sampling plans and data

---

*Suitable for direct inclusion in a contract Statement of Work

*3.4.6 NONCONFORMING MATERIAL CONTROL

A system shall be established and maintained for the identification, segregation, control, review and disposition or disposal of nonconforming material. Effective action shall be taken to correct the nonconforming material and to prevent the recurrence of nonconformances.

*3.4.6.1 Identification and Segregation

An item not meeting the drawings, specifications or other specified requirements shall be identified and documented as nonconforming and segregated from conforming items in manufacturing. When segregation is not feasible, an item shall be clearly identified as nonconforming to preclude unauthorized use.

*3.4.6.2 Missed Operations

If the item requires only completion of missed operations, it may be released for such action. Other nonconforming material shall be accompanied by a documented record of nonconformances and held for initial material review action.

*3.4.6.3 Initial Material Review

Nonconforming material offered for initial material review shall be processed by contractor personnel designated and authorized for this purpose. The nonconformances shall be appropriately examined and analyzed to determine their cause, classify them as to importance and specify disposition. Initial material review findings, recommendations and disposition actions shall be recorded on the contractor's nonconformance documentation. These actions are subject to review by the government representative. One of the following dispositions shall be made in initial material review:

a. Return to Subcontractor. Nonconforming material received from a subcontractor may be returned for correction or replacement. The contractor shall provide the subcontractor with nonconformance information and applicable instructions for the resubmittal of corrected products and corrective action report if required.

b. Remove from Use. Material obviously unfit for use and not economically repairable shall be processed in accordance with approved procedures for identifying, controlling and disposing of unusable material.

c. Return to Rework. Manufactured material found to be incomplete or able to be corrected to meet specification requirements may be released for correction or completion of operations.

d. Repair to Standard Procedure. Return for repair to acceptable condition is permitted provided that a documented standard procedure has been

---

*Suitable for direct inclusion in a contract Statement of Work

approved by the procuring activity and authority for such release action is specifically granted by the Material Review Board. Repair action shall be recorded on the contractor's nonconformance documentation.

e. Submit to Material Review Board. If none of the above dispositions is appropriate, the material shall be submitted to the Material Review Board with supporting documentation. Pending official Board disposition, such material shall be retained in hold status in a controlled area, or if impractical, otherwise controlled to prevent unauthorized use.

*3.4.6.4 Material Review Board

a. Membership. One or more decision-making contractor-government Material Review Boards shall be maintained and authorized to determine or to recommend disposition of material. Each Material Review Board, as a minimum, shall be composed of one contractor representative whose primary responsibility is engineering, one contractor representative whose primary responsibility is quality assurance and a government representative delegated by the procuring activity. A list of contractor personnel designated for membership shall be available to the government representative.

b. Responsibility. The Material Review Board shall:

(1) Assure that nonconformances are properly documented, described and classified

(2) Evaluate nonconformances to determine disposition of the products involved

(3) Assure that corrective actions are documented and there is follow-up to ensure accomplishment of such actions

(4) Provide recommendations concerning dispositions requiring the procuring activity consideration and verify implementation if approval is obtained

(5) Ensure that accurate records of Material Review Board actions are maintained and used to verify that effective preventive actions are taken

c. Disposition. In determining disposition, the Material Review Board shall consider the effect of the nonconformance upon the intended use and review records of previous Material Review Board actions on the same material. The Board shall specify one of the following:

(1) Disposition normally made in initial material review (Paragraph 3.4.6.3)

(2) If repair to a usable condition is considered possible and desirable, a request for approval shall be processed and shall include the

---

*Suitable for direct inclusion in a contract Statement of Work

contractor's proposed repair procedure and test and inspection procedure to verify acceptability

(3) If the nonconforming material is considered usable, a request for approval shall be processed in accordance with established procedures.

*3.4.6.5 Nonconformance Requests for Disposition

Requests for approval for disposition to repair or to use as-is shall be submitted to the procuring activity or its designated representative in accordance with contract requirements.

*3.4.6.6 Subcontractor Material Review Board

The contractor may, with the approval of the procuring activity and the government representative, assign Material Review Board responsibility to selected subcontractors. When this responsibility is assigned, subcontractor's Material Review Board procedures and decisions shall be subject to review by the procuring activity and the government representative at the prime contractor's plant.

3.4.7 PREPARATION FOR DELIVERY

*3.4.7.1 Material Protection

Written procedures shall be prepared and implemented for preservation, packaging, handling, transporting and storing items subject to damage or deterioration or requiring safety precautions throughout the entire receiving, manufacturing, storage and shipping activities. An appropriate procedure shall be selected from MIL-STD-794 based on an engineering review of the item and anticipated transportation and storage environments. Special packaging shall be designated when the levels and methods defined in MIL-STD-794 are considered inadequate for the item in the anticipated environments. In addition:

a. Requirements for maintenance of specific internal or external environments such as moisture content, temperature or gas pressure shall be clearly detailed on the exterior of the package and pack.

b. Inspection procedures, maintenance policy, certification procedures and intervals and the associated test equipment for special handling devices shall be documented.

c. All items requiring periodic inspection or test shall be identified. Procedures shall be provided which describe what actions are required by the stock points when there are adverse conditions or the test date is past due.

d. Items which are potentially hazardous to personnel shall be marked appropriately in accordance with government regulations.

---

*Suitable for direct inclusion in a contract Statement of Work

*3.4.7.2 Shipping Inspection

Products shall be inspected and controlled prior to shipment to assure that:

a. Products have passed satisfactorily applicable tests and inspections

b. Products have been identified, preserved, packaged and packed in accordance with applicable specifications and procedures

c. Packaging and packing have been marked in accordance with applicable specifications and procedures

*3.4.8 MANUFACTURING DOCUMENTATION CHANGE CONTROL

A system shall be established and maintained to assure manufacturing documentation change control during production. Documentation to control manufacturing and test and inspection operations will assure that:

a. Documentation utilized in the fabrication, test and inspection operations and applicable changes are under formal control

b. All pertinent documents are changed when required and the effectivity point of the change specified

c. Documents not required to support processing of approved product configuration are promptly removed and illegible documents replaced

d. Documents which identify and accompany products through the manufacturing test and inspection operations reference appropriate part number and applicable change level

e. Changes are accomplished on affected products at the authorized point and changed products are appropriately marked or identified

f. Computer software reflects changes that match the hardware changes and can be identified readily to the item to be tested

*Suitable for direct inclusion in a contract Statement of Work

3.5. TEST AND INSPECTION EQUIPMENT AND STANDARDS

3.5 TEST AND INSPECTION EQUIPMENT AND STANDARDS

The requirements of this section which are an expansion of the provisions of MIL-STD-45662 generally are applicable to a contractor's operation during both development and production. Certain of these requirements apply to an in-house operation, as well. (Also see Paragraph 3.4.2.)

As with the balance of this document, it is stressed that not all requirements of this section will apply to all projects and that those that are applicable may require tailoring or modification.

*3.5.1 CONTRACTOR TEST AND INSPECTION EQUIPMENT AND STANDARDS

The contractor shall establish and maintain a system to define, design, evaluate, approve, maintain, calibrate and control basic standards, gages, measuring and test equipment and test support equipment necessary to verify that the products presented for government acceptance conform to specification requirements. When production jigs, fixtures, tooling masters, templates, patterns and such other devices are used as media of inspection, they shall be proven accurate prior to release for use. These devices shall be included in the calibration and maintenance program.

*3.5.2 CALIBRATION AND MAINTENANCE

A calibration and maintenance program shall be established and maintained to assure the measuring devices used in the performance of the contract are accurate. Measuring devices include test and inspection equipment, test support equipment, standards and equipment controlling special processes. Measurement devices also include production tools, jigs and fixtures, gages and personally owned tools used to provide objective evidence of quality conformance.

*3.5.2.1 Procedures for Calibration and Maintenance

Documented procedures shall be maintained and used for calibration and maintenance of all measuring equipment and standards. The procedures may be a compilation of published standard practices, instrument manufacturer instructions or contractor written instructions. Calibration procedures shall require that calibrations be performed by comparison with higher accuracy level standards. The order or preference of calibration procedures shall be as follows:

a. Navy standard calibration procedures in accordance with metrology requirements list (METRL), OD 45845

b. METRL procedures modified as necessary by the contractor

c. Contractor prepared procedures or equipment manufacturer instructions

---

*Suitable for direct inclusion in a contract Statement of Work

METRL procedures modified by the contractor, contractor-prepared procedures and equipment manufacturer instructions shall include instructions necessary to enable the personnel maintaining or calibrating the devices to determine that the devices are operating properly and within prescribed limits.

*3.5.2.2 Calibration Intervals

Measuring devices shall be calibrated and maintained at periodic intervals established on the basis of stability, purpose and degree of usage. METRL shall be used to establish initial calibration intervals. Intervals shall be shortened, as required, to assure continued accuracy as evidenced by prior calibrations. Supporting data shall be required to lengthen calibration intervals beyond the initial intervals.

*3.5.2.3 Labeling of Measuring Devices

Measuring devices shall be conspicuously identified as to calibration status. Calibration labels shall show the date of calibration, by whom calibrated and due date for next calibration. Devices which do not require a complete calibration, or are to be used for indications only, shall bear labels or tags denoting the limitations. When size or functional characteristics prevent applying labels, identifying codes shall be applied to indicate calibration status and due date for next calibration. Standards used for calibration shall be identified to preclude their use as test and inspection equipment. When a station calibration is performed, a label shall be affixed to the console frame or similar common item to attest to the station calibration.

*3.5.2.4 Sealing of Measuring Devices

Access to adjustments and adjustable devices affecting the measurement capabilities of measuring devices shall be sealed to deter unauthorized entry. Seals shall be designed to be broken upon entry into the measuring device. Following station calibrations, cabinets and consoles shall be secured and sealed.

*3.5.2.5 Recall of Measuring Devices

The contractor shall provide for the mandatory recall of measuring devices for calibration and maintenance within the established intervals. Measuring devices which have not been calibrated in accordance with the established schedule shall be removed immediately from service. If physical removal is impractical, the device shall be impounded and signs or tags attached. In addition, provisions shall be made to immediately remove or impound measuring devices which have failed in one or more parameters, that show evidence of physical damage or are determined to be or suspected of being outside of their required performance limits. Measuring devices shall not be used when impounded. Approval by the government representative is required to continue use of the device if the prescribed date for calibration has been exceeded or the device is found to be outside of established accuracy limits. New or repaired measuring devices shall be calibrated prior to use.

---

*Suitable for direct inclusion in a contract Statement of Work

*3.5.2.6 Records and Analysis Concerning Measuring Devices

Records shall be established and maintained for the calibration and maintenance program. These records shall include identifying the measuring devices (i.e., nomenclature, manufacturer, model number, serial number, contractor identification, custodian, location), maintenance history of the devices and calibration information (i.e., calibration source, procedure, interval, due dates, calibration data). Calibration data shall be analyzed to determine trends of deterioration and to provide realistic revision of intervals to assure continued accuracy of the measuring devices. Criteria for recording data are as follows:

a. Qualitative Data. Only qualitative (attribute) data need to be recorded on measuring devices which are within tolerance when received for calibration.

b. Quantitative Data. Quantitative data (variables) shall be recorded when measuring devices are out of tolerance and shall include data on the out-of-tolerance parameters before and after adjustment or rework. Data also shall be recorded as required to determine performance capabilities of non-adjustable or fixed-value devices.

*3.5.2.7 Out-of-Tolerance Measuring Devices

Out-of-tolerance measuring device conditions shall be reported to the appropriate contractor manager for analysis. If it is determined that the condition had an adverse effect on the end product, the results of this analysis shall then be reported to the user and the government representative, along with a recommended course of action.

*3.5.2.8 Handling, Transporting and Storage of Measuring Devices

Measuring devices shall be protected during handling, transporting and storage in a manner that will not jeopardize measurement capabilities.

*3.5.2.9 Calibration Source

Measuring devices shall be calibrated by the contractor or by a facility using standards with calibration traceable to U.S. National Bureau of Standards or derived from accepted values of natural physical constants. If no national standards exist, the basis for calibration shall be documented. All standards shall be supported by records showing the date calibrated, assigned values and accuracy of measurements and conditions under which the results were obtained.

*3.5.2.10 Adequacy of Standards

The error of standards shall not exceed 25 percent of the allowable tolerance for the measuring devices being calibrated. Any departure from this requirement shall be submitted to the procuring activity for approval with

*Suitable for direct inclusion in a contract Statement of Work

supporting justification, including the proposed method of compensating for the calibration error.

*3.5.2.11 Environmental Controls for Measuring Devices

Measuring devices shall be calibrated, maintained and used in environments controlled to the extent necessary to assure required measurement capabilities. Due consideration shall be given to temperature, temperature rate of change, humidity, lighting, vibration, acoustic noise, dust control and cleanliness and other factors affecting precise measurements. When pertinent, these factors shall be continuously monitored and recorded.

*3.5.3 TEST AND INSPECTION EQUIPMENT DESIGN AND EVALUATION

A test and inspection equipment design and evaluation program shall be established and maintained. The program shall be documented in accordance with CDRL item number (specify). The program documentation shall describe the methods and procedures to be used.

*3.5.3.1 Test and Inspection Equipment Design

Provisions shall be made for the definition, design and evaluation of test and inspection equipment used to verify that end items conform to specifications. The total error in any measurement system shall not exceed 10 percent of the specified tolerance of each characteristic being measured. Any departure from this requirement and the proposed method to compensate for its effects shall be submitted to the procuring activity for approval. For single limit parameters, the required test equipment accuracy shall be specified.

*3.5.3.2 Test and Inspection Equipment Evaluation

Test and inspection equipment shall be evaluated to ascertain that the design, components and construction specified will provide for the measurement capabilities required for acceptance of the product. Design evaluation shall include a preliminary error analysis prior to release of the design and verification testing of the equipment as follows:

a. The error analysis shall predict test and inspection equipment errors based on information specified by manufacturers of commercial equipment, data available from previously used unique circuits and engineering estimates for new design equipment.

b. Verification testing shall be conducted to determine inherent errors in the first units of test and inspection equipment containing new design or critical measurement circuits and to verify errors that cannot be verified during the initial design phase. Verification testing shall be done under required environmental operating conditions. These tests shall be based on a sound statistical plan and shall continue long enough to demonstrate compliance with tolerance requirements. The product assurance organization shall participate in verification tests.

---

*Suitable for direct inclusion in a contract Statement of Work

Equipment errors obtained from preliminary error analysis or verification testing for each input, stimulus and measurement shall be compared with the respective product tolerances to calculate accuracy ratios.

***3.5.4 TEST AND INSPECTION STATION OPERATIONAL PROOFING AND CORRELATION**

A program shall be established and maintained for the operational proofing and correlation of test and inspection stations used to verify that products conform to specification requirements.

***3.5.4.1 Test Station Operational Proofing**

Each test and inspection station shall be subjected to operational proofing tests under actual operating conditions. The station shall include test and inspection equipment, ancillary equipment, support equipment, fixtures, cabling, checkout tapes, operating personnel and documentation for operating and calibrating the equipment. These tests shall verify completeness and adequacy of the operational and maintenance procedures, calibration procedures, supporting test hardware, compatibility of the station with the product, ease of operation and maintenance and detect any inherent shortcomings. Deficiencies detected during operational proofing shall be corrected prior to station use for product acceptance. Operational proofing test procedures shall be developed in accordance with CDRL item number (specify). Test station operating personnel shall participate in the operational proofing tests performed in accordance with these procedures. The government representative shall be notified prior to the start of operational proofing tests. Operational proofing of duplicate test and inspection stations need only be directed toward proofing of the equipment involved, provided the documentation remains unchanged. Operational proofing test results shall be documented to authorize use of the test and inspection stations.

***3.5.4.2 Test Station Logs**

Test station logs shall be maintained to record station history including station operational proofing, calibrations, broken station seals, equipment servicing, authorized use status and explanations for all modifications and breaks-of-station. Log entries shall be maintained current and each entry dated and signed by authorized personnel.

***3.5.4.3 Test Station Correlation**

When test and inspection stations are used to verify conformance to specification requirements of identical type products at more than one facility, the contractor responsible for the test station design shall conduct a correlation program to detect and correct conditions contributing to significant differences in test results between testing facilities.

A correlation report shall be documented for each test station correlation delineating problems encountered during testing and corrective actions taken.

---

*Suitable for direct inclusion in a contract Statement of Work

APPENDICES

APPENDIX A

PRODUCT ASSURANCE PROGRAM REQUIREMENTS CHECKLIST

APPENDIX A

PRODUCT ASSURANCE PROGRAM REQUIREMENTS CHECKLIST

1. The individual requirements included in this Product Assurance Guide must be carefully selected and tailored for each procurement. In general, the requirements in Sections 3.1 and 3.2 are applicable to both development and production contracts; the requirements of Section 3.3, to development contracts and the requirements of Section 3.4, to production contracts. The requirements of Section 3.5 should be selectively applied to both development and production contracts based on the extent of contractor responsibility for test and inspection equipment. The following checklist is provided as an aid to organizing the contractual requirements for an anticipated procurement.

2. Review each requirement (paragraph) of the Product Assurance Guide and determine the applicability of that requirement to the anticipated procurement. If the requirement is applicable, check the "Applicable" column. If the requirement is not applicable, check the "Not Applicable" column. If the requirement is applicable only with addition, deletion or other modification or tailoring, insert the word "Mod" in the "Applicable" column.

3. Wherever "Mod" is entered in the "Applicable" column, the requirement should be rewritten to satisfy the needs of the procurement.

Product Assurance Program Requirements

Paragraph	Requirement*	Applicable (or Mod)	Not Applicable
3.1.1.2	Contractor Product Assurance Program Management		
3.1.2.1	Product Assurance Program Planning		
3.1.2.2.1	Product Assurance Program Plan		
3.1.3.1	Product Assurance Program Documentation		
3.1.4.1	Education and Training		
3.1.4.2	Certification of Personnel		
3.1.5.1	Audit Conduct		
3.1.5.2	Audit Report and Corrective Action		
3.1.6.1	Product Assurance Data System		
3.1.7.1	Problem/Failure Reporting		
3.1.7.2	Problem/Failure Investigation and Analysis		
3.1.7.3	Corrective Action		
3.1.8.1	Technical Data Quality Program		
3.1.9.1	Government-furnished Material or Equipment		
3.1.10.1	Use of Sampling		
3.1.11.1	Collection of Quality Cost Data		
3.1.12.6.1	Configuration Management Program*		
3.1.13.1	Computer Software Quality Assurance		
3.1.14.3.1	Integrated Logistics Support Program*		
3.1.15.5.1	Reliability Program*		
3.1.15.5.2	Maintainability Program*		
3.1.15.5.3	Availability Program		

* The detailed requirements for these must be established based on the particular project needs

Paragraph	Requirement*	Applicable (or Mod)	Not Applicable
3.1.16.2.1	System Safety Program*		
3.1.16.2.2	System Safety Hazard Analyses		
3.1.16.2.2.1	Preliminary Hazard Analysis		
3.1.16.2.2.2	Subsystem Hazard Analysis		
3.1.16.2.2.3	System (Interface) Hazard Analysis		
3.1.16.2.2.4	Operation and Support Hazard Analysis		
3.1.16.2.3	Safety Analyses Time-Phasing		
3.1.17.1.1	Quality Assurance Program*		
3.1.18.1.1	Human Engineering Program*		
3.1.19.2	Procurement Data Package Requirements*		
3.1.19.3	Use of Limited Rights or Proprietary Equipment and Data		
3.1.20.1	Packaging, Handling, Storage and Transportability Program		
3.2.1.1	Selection of Procurement Source		
3.2.2.1	Approved Source List of Subcontrators		
3.2.3.1	On-Site Surveys of Subcontractor Operations		
3.2.5.1	Basic Technical Requirements to Be Included In Procurement/Purchase Documents		
3.2.5.2	Procurement/Purchase Document Detailed Provisions		
3.2.6.1	Procurement/Purchase Document Review		
3.2.7.1	Procurement/Purchase Document Change Control		
3.2.8.1	Contractor/Subcontractor Coordination and Corrective Action		

* The detailed requirements for these must be established based on the particular project needs

Paragraph	Requirement*	Applicable (or Mod)	Not Applicable
3.2.9.1	Government Source Inspection		
3.2.9.2	Contractor Source Inspection		
3.3.1.1	Mission/System Analysis		
3.3.1.2	Design Analysis		
3.3.1.3.1	Design Practices and Documentation		
3.3.1.4	Parts and Materials Selection		
3.3.1.5	Key Components		
3.3.1.6	Control of Key Components		
3.3.1.7.1	Preliminary Design Review (PDR)*		
3.3.1.7.2	Critical Design Review (CDR)*		
3.3.1.7.3	Internal Design Review		
3.3.2.1	Integrated Test Program Plan		
3.3.2.2	Test Documentation		
3.3.3.1	Development Tests		
3.3.3.2	Engineering Evaluation Tests		
3.3.3.3	Qualification Tests		
3.3.3.4	Test Reports		
3.3.4.1	Test and Inspection of Hardware During The Validation Phase		
3.3.4.2	Test and Inspection of Hardware During the Full-Scale Development Phase		
3.3.5	Material Identification and Handling		
3.3.6	Manufacturing Control During Development		
3.3.7.1	Producibility Analysis		

* The detailed requirements for these must be established based on the particular project needs

Paragraph	Requirement*	Applicable (or Mod)	Not Applicable
3.3.7.2	Readiness for Production Review		
3.4.1.1	Review for Production Operations		
3.4.2.1	Production Product Assurance Program		
3.4.3.1	Parts and Materials Control		
3.4.3.2	Process Controls		
3.4.3.3	Assembly Operations		
3.4.3.4	Environmental and Cleanliness Control		
3.4.3.5	Workmanship Standards		
3.4.4	Test and Inspection Planning		
3.4.5	Quality Verification		
3.4.5.1	Receiving Test and Inspection		
3.4.5.2	In-Process Test and Inspection		
3.4.5.3	Nondestructive Testing Processes		
3.4.5.4	Configuration Verification		
3.4.5.5	Acceptance Test and Inspection		
3.4.5.6	Special Tests and Inspection		
3.4.5.7	Inspection Indications		
3.4.6	Nonconforming Material Control		
3.4.6.1	Identification and Segregation		
3.4.6.2	Missed Operations		
3.4.6.3	Initial Material Review		
3.4.6.4	Material Review Board		
3.4.6.5	Nonconformance Requests for Disposition		
3.4.6.6	Subcontractor Material Review Board		
3.4.7.1	Material Protection		

Paragraph	Requirement	Applicable (or Mod)	Not Applicable
3.4.7.2	Shipping Inspection		
3.4.8	Manufacturing Documentation Change Control		
3.5.1	Contractor Test and Inspection Equipment and Standards		
3.5.2	Calibration and Maintenance		
3.5.2.1	Procedures for Calibration and Maintenance		
3.5.2.2	Calibration Intervals		
3.5.2.3	Labeling of Measuring Devices		
3.5.2.4	Sealing of Measuring Devices		
3.5.2.5	Recall of Measuring Devices		
3.5.2.6	Records and Analysis Concerning Measuring Devices		
3.5.2.7	Out-of-Tolerance Measuring Devices		
3.5.2.8	Handling, Transporting and Storage of Measuring Devices		
3.5.2.9	Calibration Source		
3.5.2.10	Adequacy of Standards		
3.5.2.11	Environmental Controls for Measuring Devices		
3.5.3	Test and Inspection Equipment Design and Evaluation		
3.5.3.1	Test and Inspection Equipment Design		
3.5.3.2	Test and Inspection Equipment Evaluation		
3.5.4	Test and Inspection Station Operational Proofing and Correlation		
3.5.4.1	Test Station Operational Proofing		
3.5.4.2	Test Station Logs		
3.5.4.3	Test Station Correlation		

APPENDIX B

PRODUCT ASSURANCE DOCUMENTATION REQUIREMENTS CHECKLIST

APPENDIX B

PRODUCT ASSURANCE DOCUMENTATION REQUIREMENTS CHECKLIST

1. The product assurance documentation requirements referred to in this Product Assurance Guide can be considered as falling into two categories:

- Those documents that should be submitted for Navy Project Office approval prior to the contractor proceeding with the work

- Those documents which generally are submitted for Navy Project Office information

While all documents generated by the contractor conceivably could be required to be submitted for Navy Project Office approval prior to the contractor proceeding with his work, generally this is neither desirable nor practical. The checklist identifies those product assurance documents, not including computer software items, which typically are submitted for Navy approval where the contract requires their preparation. It is noted that the checklist includes documents typical for both development and production contracts so it is unlikely that all would be required in a given instance.

2. Where documents (e.g., various plans) are to be submitted to the Navy Project Office for advance approval, the Contract Data Requirements List (DD 1423) should reflect this requirement by the inclusion of an "A" (advance written approval required) in Block 8 and a statement in Block 16 to the effect that "NOSC will review and provide comments within (specify number) days." Additionally, Block 7 usually should indicate "DD" (Inspection and acceptance of the final document at destination utilizing the DD Form 250), although "LT" (DD-250 not required) may be appropriate in certain cases. "LT" should not be used for documents having anticipated future use in production or in the Fleet such as engineering drawings, specifications, technical manuals, etc.

3. The checklist also references "suggested data item descriptions" for each document listed although it should be recognized that other DIDs may be satisfactory or, perhaps, preferable under certain conditions. Attention is called to the footnotes which provide additional guidance in utilizing the referenced DIDs. The Acquisition Management Systems and Data Requirements Control List (AMSDL-DOD 5000.19-L Vol II) shows all currently approved DIDs and should be used to verify the approval status of all items prior to their inclusion in a contract or order. Block 16 of the DD 1423 may be used to modify DID requirements to suit the needs of the project.

Paragraph	Documentation Typically Submitted for Project Office Approval	Suggested Data Item Descriptions	Appli-cable	Not Appli-cable
	PRODUCT ASSURANCE			
3.1.2.2.1	Product Assurance Program Plan	DI-R-1700 [1]		
	CONFIGURATION MANAGEMENT			
3.1.12.6.1	Configuration Management Program Plan	DI-E-2035		
Appendix D, 6.1 Appendix E, 9	Configuration Status Accounting Report(s) [2]	DI-E-2039		
Appendix D, 7.1	Configuration Audit Plan	DI-E-2036		
Appendix D, 7.1.1	Functional Configuration Audit Agenda/Report [3]	UDI-E-26064		
Appendix D, 7.1.2	Physical Configuration Audit Agenda/Report [3]	UDI-E-26064		
	Engineering Changes, Deviations and Waivers (Short Form) [4]	DI-E-5034B		
Appendix D, 5.4 Appendix E, 1	Engineering Changes, Deviations and Waivers [5]	DI-E-5035B		
3.1.12.1.1	Functional Baseline Description	UDI-E-22167B [6]		
3.1.12.1.2	Allocated Baseline Description	UDI-E-22100B [6]		
3.1.12.1.3	Product Baseline Description	UDI-E-22102B [6]		
	As-Built Configuration Data Listing	UDI-E-20409B		
	INTEGRATED LOGISTICS SUPPORT (ILS)			
3.1.14.3.1	ILS Plan	(7)		
3.1.14.3.1a	Support and Test Equipment Requirements	DI-V-2074		
3.1.14.3.1b	Level-of-Repair Analysis Report	DI-L-2085A		
3.1.14.3.1c	Technical Manuals	(8)		
Appendix F, 1.1	Technical Manual Outline/Book Plan	DI-M-2041		
Appendix F, 1.2	Technical Manual Manuscript Copy	DI-M-2042		
Appendix F, 6.1	Validation and Verification Plan	UDI-M-23928		

Paragraph	Documentation Typically Submitted for Project Office Approval	Suggested Data Item Descriptions	Applicable	Not Applicable
3.1.14.3.1d	Maintenance Plan	UDI-L-20110		
3.1.14.3.1e	Standardization Program Plan	UDI-R-23975		
3.1.14.3.1f	Training and Training Equipment Plan (9)	DI-H-2023		
3.1.14.3.1g	Maintenance Requirements Cards	UDI-L-22323B		
	Various Provisioning Documents	(10)		
	RELIABILITY			
3.1.15.5.1	Reliability Program Plan	DI-R-7079 (22)		
3.1.15.5	Reliability Mathematical Model	DI-R-7081		
3.1.15.5.1a	Reliability Prediction Report	DI-R-7082		
3.1.15.5.1a	Reliability Allocation Report	DI-R-2114		
3.1.15.5.1c	Failure Modes, Effects and Criticality Analysis Plan	DI-R-7086		
3.1.15.5.1c	Failure Modes, Effects and Criticality Analysis Report	DI-R-7085		
3.1.15.5.1h	Reliability Demonstration Test Plan	DI-R-7033		
3.1.15.5.1h	Reliability Demonstration Test Procedures	DI-R-7035		
3.1.15.5.1h	Reliability Demonstration Test Report	DI-R-7034		
3.1.15.5.1h	Reliability Corrective Action Plan	DI-R-7038		
	MAINTAINABILITY			
3.1.15.5.2	Maintainability Program Plan	DI-R-5190 (22)		
3.1.15.5	Maintainability Mathematical Model	DI-R-1742		
3.1.15.5.2a	Maintainability Prediction Report	DI-R-7082		
3.1.15.5.2a	Maintainability Allocation Report	DI-R-2114		
3.1.15.5.2d	Maintainability Demonstration Test Plan	DI-R-2129		
3.1.15.5.2d	Maintainability Demonstration Test Procedures	UDI-T-23711		

Paragraph	Documentation Typically Submitted for Project Office Approval	Suggested Data Item Descriptions	Appli-cable	Not Appli-cable
3.1.15.5.2d	Maintainability Demonstration Test Report	DI-R-2130A		
3.1.15.5.2d	Maintainability Corrective Action Plan	DI-R-7038 (20)		
	SYSTEM SAFETY			
3.1.16.2.1	System Safety Program Plan	DI-H-7047		
3.1.16.2.2.1	Preliminary Hazard Analysis Report	DI-H-7048		
3.1.16.2.2.2	Subsystem Hazard Analysis Report	DI-H-7048		
3.1.16.2.2.3	System (Interface) Hazard Analysis Report	DI-H-7048		
3.1.16.2.2.4	Operation and Support Hazard Analysis Report	DI-H-7048		
	QUALITY ASSURANCE			
3.1.17.3.1	Quality Assurance Program Plan (11)	UDI-R-23743B		
3.4.4	Production Inspection and Test Plan	UDI-R-20403C		
3.4.5.5	Production Inspection and Test Procedures	UDI-R-20403C		
3.4.5.6a	Purchased Items Requiring First Article Inspection	UDI-E-21246A		
3.4.5.6b	First Article Qualification Test Plan	DI-T-5315A		
	HUMAN FACTORS			
3.1.18.1.1	Human Engineering Program Plan	DI-H-7051		
3.1.18.1.1	Human Engineering Dynamic Simulation Plan	DI-H-7052		
3.1.18.1.1	Human Engineering Test Plan	DI-H-7053		
3.1.18.1.1	Human Engineering System Analysis Report	DI-H-7054		
3.1.18.1.1	Human Engineering Test Report	DI-H-7058		
	ENGINEERING DRAWINGS/SPECIFICATIONS			
3.1.19.2	Engineering Drawings	DI-E-7031 (12)		
3.1.19.2	Engineering Drawing Tree (16)	DI-E-5349		

Paragraph	Documentation Typically Submitted for Project Office Approval	Suggested Data Item Descriptions	Appli-cable	Not Appli-cable
3.1.19.2	Specifications[15]	UDI-E-22154B[15]		
3.1.19.2	Specification Tree[16]	UDI-E-20235		
3.1.14.3.1e	Program Parts Selection List	DI-E-7027		
3.1.15.5.1b	Non-Standard Part Approval Requests	DI-E-7028A		
3.1.19.2	Installation Data Package	DI-E-30115[17]		
	DESIGN REVIEWS			
3.3.1.7.1,.2	Design Review Agenda	DI-A-3029/ S-105-1		
3.3.1.7.1,.2	Design Review Data Package	DI-E-5423[18]		
3.3.1.7.1	Preliminary Design Review Report	DI-E-3118		
3.3.1.7.2	Critical Design Review Report	DI-E-3118		
	COMPUTER SOFTWARE			
3.1.13	Various Computer Software Data Items	[19]		
	ENGINEERING TEST AND EVALUATION			
3.3.2.1	Master Test Plan	UDI-T-20031C		
3.3.2.2a	Test Plan	DI-T-5204[23]		
3.3.2.2b	Test Procedures[14]	UDI-T-20503		
3.3.3.1	Component/Subsystem Test Plan	DI-T-1903		
3.3.3.4	Test Reports[14]	DI-T-2072[13]		
3.3.3.3	Qualification Test Plan	DI-T-5204[21]		
3.3.3.4	Qualification Test Reports	DI-T-2072[13]		
	MISCELLANEOUS			
--	EMI Control Plan	DI-R-7061		
--	EMI/EMC Test Plan	DI-R-7063		
--	Work Breakdown Structure	DI-A-1004[24]		

APPENDIX B FOOTNOTES

(1) DID, which is the only one authorized by the AMSDL for general use, requires updating and modification. Utilize Block 16 of the CDRL to change as required. Note that DID does not include system safety, human engineering, configuration management and integrated logistics support. See Paragraph 3.1.2.2.1 for guidance on establishing requirements for product assurance program plans.

(2) The intital report should be approved for format and content. Subsequent reports may be submitted for project office information. Include in Block 16 of CDRL: "Report shall include all ECPs, deviations and waivers, regardless of class or type."

(3) The initial submittal, prior to the audit, should present the audit agenda. A second submittal, following the audit, should include the audit results.

(4) DI-E-5034B, which is based on DOD-STD-481, is recommended for use in conjunction with provisioning parts reprocurements. For procurement of systems or major equipment items use DI-E-5035B (based on DOD-STD-480).

(5) See footnote (4).

(6) That portion of the baseline description which is intended for utilization in future lifecycle phases (e.g., production) should be identified and its format requirements established; e.g., the content and format of that portion of the "Product Baseline Description," which will be specified in production as the authorized fabrication configuration, should be established. Generally, such listing would include, as a minimum, all engineering drawings, associated lists, product specifications, special manufacturing or calibration or adjustment procedures, etc., and would include the currently approved revision of each such document and would list all approved but currently unincorporated ECPs which affect those documents.

(7) Each of the individual systems commands and various project offices have originated Data Item Descriptions for ILS plans. These include:

Originator	DID	Reference Documents
NAVSEA (ORD)	UDI-L-20098	OR-30
NAVSEA (SHIPS)	UDI-L-23419A	DOD Dir. 4100.35, NAVMATINST 4000.20A
NAVELEX	UDI-L-22316A	MIL-STD-1369
NAVAIR	UDI-L-21012	13 Supplementary DIDs
HQMC	DI-L-4600	HQO P4105.1, NAVMC 2644
PMS-302	UDI-L-23037	DOD Dir. 4100.35C, NAVMATINST 4000.20A
PMS-302	UDI-L-23666	NAVMATINST 4000.20A

It is noted that UDI-L-23419A is a very comprehensive document; however, it may contain requirements (such as Paragraph 10.4.14 — "Meeting Minutes") which may not be needed.

(8) Since there is a wide variation in technical manual subject matter and types, it is recommended that NOSC Code 441 be contacted for assistance in the selection of appropriate DIDs.

(9) Other training related data items may be required for submittal for government approval, including:

Training Course/Curriculum Outline	DI-H-2026
Instructor/Lesson Training Course Guides	DI-H-2073
Training Course Guide, Student's	DI-H-2102A
Materials, Factory Training Curriculum	DI-H-2171
Report, Analysis, Task and Skill	DI-H-2025

(10) Various provisioning data items which may be required for submittal for government approval include:

Interim Support Item List (ISIL)	DI-V-7006
Design Change Notices	DI-V-7009
Provisioning and Other Preprocurement Screening Data	DI-V-7016C
Provisioning Parts List (PPL)	DI-V-7002
Supplementary Provisioning Technical Documentation (SPTD)	DI-V-7000
Common and Bulk Items List (CBIL)	DI-V-7008
Long Lead Time Items List (LLTIL)	DI-V-7004
Tools and Test Equipment List (TTEL)	DI-V-7007
Repairable Items List (RIL)	DI-V-7005

(11) For non-complex items, the requirements of MIL-Q-9858 (UDI-R-23745B) may be excessive and the requirements of MIL-I-45208 (DI-R-4803) may be more appropriate. Refer to Paragraph 3.1.17.1 for guidance.

(12) In addition to the DID, the ordering data requirements of DOD-D-1000B, Paragraph 6.2.1 must be included. Refer to Paragraph 3.1.19.1 for guidance.

(13) The test report shall be required to meet the format requirements of MIL-STD-831 unless contractor format is specified per Paragraph 10.1.b.

(14) It is recommended that only those test procedures and reports concerning "key" engineering development tests are submitted for government approval. Other test procedures and reports should be submitted for information.

(15) Specifications can be of several types and forms (reference MIL-S-83490), as follows:

<u>Specification Types</u>

Type A	System Specification
Type B	Development Specifications
Type B1	Prime Item
Type B2	Critical Item
Type B3	Non-Complex Item
Type B4	Facility or Ship
Type B5	Computer Program

Type C	Product Specifications
Type C1a	Prime Item Function
Type C1b	Prime Item Fabrication
Type C2a	Critical Item Function
Type C2b	Critical Item Fabrication
Type C3	Non-Complex Item Fabrication
Type C4	Inventory Item
Type C5	Computer Program
Type D	Process Specification
Type E	Material Specification

Specification Forms

Form 1	Specifications to Military Standards
Form 1a	With Maximum Format Control
Form 1b	With Limited Format Control
Form 2	Specifications to Commercial Practices, with Supplemental Military Requirements
Form 3	Specifications to Commercial Practices

UDI-E-22154B can be utilized to procure any of the above specification types, however, both the type and the form must be specified in Block 16 of the CDRL.

UDI-E-20600B may be used to procure NAVSEA WS series weapons specifications where the item to be procured is peculiar to NAVSEA and a military specification is not warranted.

(16) Government approval of the drawing and specification trees is recommended as a means of ensuring government-contractor communication regarding appropriate assembly level structuring of the system which must be closely associated with the logistic support concept, particularly the provisioning and repair level requirements.

(17) It is recommended that, in addition to citing the DID, the following requirement be placed in Block 16 of the CDRL:

"The installation drawings are to be prepared to the Level I requirements of DOD-D-1000, and to DOD-STD-100C. If a manual is to be furnished, it is to be provided in addition to, not in lieu of, the installation drawings."

(18) It is recommended that the requirements be amplified in Block 16 of the CDRL.

(19) It is recommended that Code 9133 be contacted for appropriate computer software data items.

(20) Utilize Block 16 of CDRL to modify DID for application to maintainability program.

(21) DI-T-5204 should be reviewed to determine if all requirements are applicable. Unnecessary requirements can be deleted utilizing Block 16 of the CDRL.

(22) DI-R-3533 may be used where a combination reliability/maintainability program plan is desired.

(23) Documents a total test program including test procedures.

(24) DI-A-1004 describes a basic MIL-STD-881 work breakdown structure. For a more comprehensive requirement which includes WBS element definition and cost information use UD1-F-23863B.

APPENDIX C

PROCUREMENT QUALITY ASSURANCE REQUIREMENTS
OF
DEFENSE ACQUISITION REGULATION
(DAR)

APPENDIX C

PROCUREMENT QUALITY ASSURANCE REQUIREMENTS
OF
DEFENSE ACQUISITION REGULATION
(DAR)
SECTION XIV

Scope of Section. This Section prescribes policies and procedures to assure that supplies and services procured by the Department of Defense conform to the quality and quantity set forth in the contract and for the acceptance functions associated therewith.

Definitions. As used in this Section, the words and terms described in this paragraph shall have the meanings set forth below.

1. Government Procurement Quality Assurance means the Government function by which the Government determines whether a contractor has fulfilled his contract obligations pertaining to quality and quantity. This function is related to and generally precedes the act of acceptance.

2. Contract Quality Requirements means the detailed requisites for quality incumbent on the contractor, consisting of all quality requirements contained in a contract; and the detailed contractual requisites incumbent on the contractor to substantiate conformance of product or service to quality requirements of the contract.

3. Inspection means the examination and testing of supplies or services (including, when appropriate, raw materials, components, and intermediate assemblies) to determine whether they conform to contract requirements.

4. Testing is an element of inspection and generally denotes the determination by technical means of the properties or elements of supplies, or components thereof, including functional operation, and involves the application of established scientific principles and procedures.

5. Subcontractor means any supplier, distributor, vendor, or firm which furnished supplies or services to or for a prime contractor or another subcontractor.

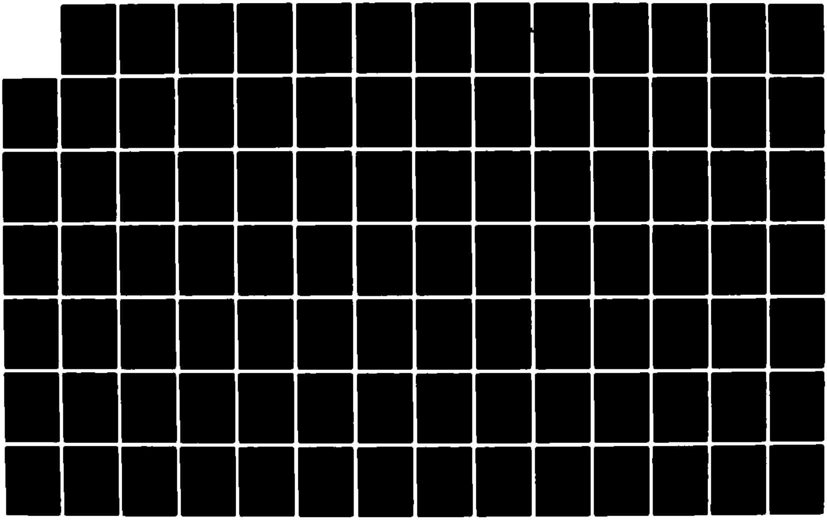
6. Acceptance means the act of an authorized representative of the Government by which the Government assumes for itself, or as agent of another, ownership of existing and identified supplies tendered or approves specific services rendered, as partial or complete performance of the contract on the part of the contractor.

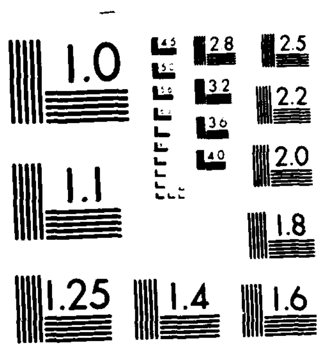
7. Off-The-Shelf Item means an item produced and placed in stock by a contractor prior to the contractor receiving orders or contracts for the sale of the item. The contractor may produce the items to either commercial or military/federal item specifications or descriptions. Off-the-shelf items include items stocked by distributors for which Government contracts may be received.

AD-A126 678 PRODUCT ASSURANCE REQUIREMENTS GUIDE FOR NAVAL OCEAN SYSTEMS CENTER PROJECTS(U) NAVAL OCEAN SYSTEMS CENTER SAN DIEGO CA 21 DEC 82 NOSC/TD-432

3/5

UNCLASSIFIED F/G 5/1 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Part 1 - General

Types of Contract Quality Requirements. There are fi basic categories of contract coverage for assuring conformance of produc or services to contract requirements:

(1) not including any specific quality requirement in the contract, in which case the Government does not perform any procurement quality assurance actions at source, but instead relies on the contractor's internal control to obtain the supplies or services specified in the contract;

(2) contractor responsibility provisions (14-101.1);

(3) standard inspection requirement (14-101.2);

(4) MIL-I-45208 Inspection System Requirement (14-101.3); and

(5) MIL-Q-9858 Quality Program Requirement (14-101.4); MIL-I-45208, Inspection System Requirement, or MIL-Q-9858, Quality Program Requirement, shall not be specified for off-the-shelf items.

(DAR-14-101.1) Contractor Responsibility Provisions, making the contractor responsible for the inspection and test of product before offering them to the Government, are effected by:

(1) citing in the contract Federal-Military Specifications which contain a "Responsibility for Inspection" clause in Section 4, "Quality Assurance Provisions" of the Specifications;

(2) citing in the contract Federal-Military drawings which carry a note relative to the contractor's responsibility for inspection and test and

(3) including the clause 7-103.24 in the contract.

(DAR-14-101.2) Standard Inspection Requirement is a requirement that the contractor maintain an inspection system acceptable to the Government. This requirement is included in the standard inspection clauses (see, for example, paragraph (e) of the Inspection clause in 7-103.5(a)) and is not further defined by a Government specification. This requirement is appropriate when for reasons of practicability (e.g., purchase of a commercial item) or because of the nature of the supplies (i.e., the item serves a function that is not materially or consequentially related to military operations), it is not considered necessary to describe further what constitutes an acceptable inspection system.

(DAR-14-101.3) Inspection System Requirement is a requirement, in addition to the Standard Inspection Requirement, that the contractor establish and maintain an inspection system in accordance with a Government specification. This requirement shall be referenced in contracts when technical

requirements are such as to require control of quality by in-process as well as final end item inspection, including control of such elements of the manufacturing process as measuring and testing equipment, drawings and changes, inspection, documentation and records. The objectives and essential elements of an inspection system are prescribed in MIL-I-45208, which shall be referenced in contracts when an inspection system requirement has been established.

(DAR-14-101.4) Quality Program Requirement is a requirement, in addition to the Standard Inspection Requirement, that the contractor establish and maintain a quality program in accordance with a Government specification. Such a requirement shall be established when the technical requirements of the contract are such as to require control of work operations, in-process controls, and inspection, as well as attention to other factors (e.g., organization, planning, work instructions, documentation control, advanced metrology). The objectives and essential elements of a quality program are prescribed in MIL-Q-9858 which shall be referenced in contracts when a quality program requirement has been established.

Criteria for Applying Contract Quality Requirements

(a) Suggested aids in proper selection of contract quality requirements:

(1) Classification by type of contract quality requirement:

(A) No Specific Contract Quality Requirement. Generally used in purchases under Section III, Part 6, where there is no specific obligation on the contractor for the performance of inspection and no Government procurement quality assurance actions can be performed at source.

(B) Contractor Responsibility Clause. (See 14-101.1.) Use of this requirement alone is restricted to purchases under Section III, Part 6.

(C) Standard Inspection Requirement. (See 14-101.2.) Must be used on all fixed price supply contracts over $10,000. It may be used alone or in conjunction with Contractor Responsibility clause on purchases under Section III, Part 6. It must be used with the MIL-I-45208 and MIL-Q-9858.

(D) MIL-I-45208 and MIL-Q-9858. (See 14-101.3 and 14-101.4.) Technical personnel shall be consulted before including one of these specifications in a contract.

(2) Classification by contract item technical description:

(A) Commercial (catalogs, drawings, industrial standards).

(B) Military-Federal (drawings, specifications).

(C) Off-the-shelf (See 14-001.7).

(3) Classification by type of items

(A) Complex items have quality characteristics, not wholly visible in the end item; for which contractual conformance must progressively be established through precise measurements, tests and controls accomplished during purchasing, manufacturing, assembling, and functional operations either as an individual item or in conjunction with other items.

(B) Noncomplex items have quality characteristics for which simple measurement and test of the end item is sufficient to determine conformance to contract requirements.

(4) Classification by type of application

(A) Critical. A critical application of an item is one in which the failure of the item could injure personnel or jeopardize a military mission. Critical items may be either:

(1) Peculiar, meaning items which have only one application; or

(2) Common, meaning items which have multiple applications.

Whether peculiar or common, purchases of critical items must have contract quality requirements.

(B) Noncritical. A noncritical application is any application which is not critical. Noncritical items may also be either peculiar or common.

(b) Application of the Criteria. Decisions must be made as to whether the item is off-the-shelf, commercial or Military-Federal, complex or noncomplex and whether its application is critical or noncritical, peculiar or common.

Once these decisions are made, the table below will indicate the proper contract quality requirement.

Item Technical Description	Kind of Item	Application	Type of Contract Quality Requirement
Commercial	Noncomplex	Noncritical Common	(1)
Commercial	Noncomplex	Noncritical Peculiar	(1)
Commercial	Noncomplex	Critical	(3)
Commercial	Complex	Noncritical Common	(1)

Item Technical Description	Kind of Item	Application	Type of Contract Quality Requirement
Commercial	Complex	Noncritical Peculiar	(3)
Commercial	Complex	Critical	(4)
Military-Federal	Noncomplex	Noncritical Common	(3)
Military-Federal	Noncomplex	Noncritical Peculiar	(3)
Military-Federal	Noncomplex	Critical	(4)
Military-Federal	Complex	Noncritical Common	(3)
Military-Federal	Complex	Noncritical Peculiar	(4)
Military-Federal	Complex	Critical	(5)
Off-the-Shelf	All	Noncritical	(1)
Off-the Shelf	All	Critical	(3)

(c) The table in (b) above is intended for use as a guide in selecting the contract quality requirement normally considered appropriate for the given item criteria. However, where circumstances warrant, a contract quality requirement of a greater or lesser degree than that arrived at through use of this table may be specified by the PCO except for off-the-shelf items as previously defined.

Responsibilities of the Contractor

(a) The contractor is responsible for carrying out his obligations as set forth in the terms and conditions of the contract and in the applicable specifications. Most Department of Defense contracts include, or reference, standard requirements, such as those in general provisions, special clauses for an inspection system or quality program, and performance and product specification requirements. The contractor is responsible for controlling product quality and for offering to the Government for acceptance only those supplies and services that conform to contract requirements and, when required, for maintaining and furnishing substantiating evidence of this conformance.

(b) The control of quality by the contractor may relate to, but is not limited to:

(1) manufacturing processes, to assure that the product is produced in accordance with technical requirements;

(2) drawings, specifications, and engineering changes, to assure that manufacturing methods and operations reflect technical requirements;

(3) testing and examination, to assure that practices and equipment provide the means for optimum evaluation of characteristics subjected to inspection;

(4) reliability and maintainability assessment (life, endurance, and continued readiness);

(5) fabrication and delivery of products to assure that only conforming products are tendered to the Government;

(6) technical documentation, including drawings, specifications, handbooks, manuals, and other technical publications;

(7) preservation, packaging, packing and marking.

Responsibilities of the Government

(a) The Government shall determine the type and extent of Government procurement quality assurance actions required, based upon the particular procurement. These actions may include:

(1) inspection of supplies and services;

(2) review of the contractor's inspection system, quality program, or of any other means employed by the contractor to control quality and to comply with contract requirements;

(3) maintenance of Government records to reflect actions, deficiencies, and corrective measures; and

(4) review and evaluation of quality information, including reports from the user, to initiate required corrective actions or to adjust Government procurement quality assurance actions.

(b) Subcontracts. Government procurement quality assurance at subcontractor's plants shall be performed only when necessary to assist the contract administration office cognizant at the prime contractor's plant.

(c) Specialized Inspections Reserved to the Government. Although contracts generally require that contractors are responsible for performing inspection prior to submitting supplies to the Government, there are situations

when contracts will provide for specialized inspections to be performed solely by the Government. Among situations for which specialized Government inspection is required are the following:

(1) test requirements necessitate the use of specialized test equipment or facilities not ordinarily available in suppliers' plants or commercial laboratories (e.g., ballistic testing of ammunition, unusual environmental tests, or simulated service tests); or

(2) the contract requires Government testing for first article approval.

Part 2 - Responsibilities of Government Organizations

Organization Responsible for Technical Requirements

(a) The activity responsible for technical requirements (e.g., specifications, drawings and standards) is responsible for prescribing inspection, testing, or other contract quality requirements that are essential to assure the integrity of products and services.

(b) To the extent feasible, alternative but substantially equivalent inspection methods shall be provided in order to obtain wide competition and low cost. Contractor-recommended alternatives may be authorized when in the interest of the Government and after approval by the activity responsible for technical requirements.

(c) The activity responsible for technical requirements may also prepare instructions regarding the type and extent of Government inspections pertaining to contracts for specific supplies or services that are complex or for which unusual requirements have been established. Such instructions shall be kept to a minimum taking into account the policy contained in DAR 14-403(a). Normally, issuance of these instructions will not be appropriate for standard commercial items except when items having critical characteristics are being purchased. After issuance of these instructions, production problems, product-oriented visits, user experience and input from the contract administration office shall be analyzed periodically to determine whether conditions warrant a change in type and extent of the inspection requirements. Such analysis may result in decreasing or increasing Government inspection. These instructions shall be prepared on a contract-by-contract basis and shall not be issued:

(1) as a substitute for incomplete contract quality requirements;

(2) where the contract does not impose equal or greater inspection requirements on the contractor;

(3) encompassing broad or general designations such as "all requirements," "all characteristics," or "all characteristics in the classification of defects;"

(4) on routine administrative procedures; or

(5) specifying continued inspection requirements when statistically sound sampling will provide an adequate degree of protection.

(d) In the preparation of such instructions, the technical activity shall consider, to the extent available and applicable, such factors as:

(1) the past quality history of the contractor;

(2) the criticality of the material procured in relation to its ultimate use considering such factors as reliability, safety and interchangeability;

(3) problems encountered in the development of the product;

(4) problems encountered in the acquisition of the same or similar material;

(5) previously generated feedback data from receiving, testing or using activities; and

(6) other contractor's experience in overcoming manufacturing problems.

Purchasing Office

The purchasing office is responsible after coordinating, where necessary, with the technical activity for contractually formalizing requirements for quality and, within the provisions of DAR 14-201(c), issuing Government inspection instructions to the contract administration office. The purchasing office shall include, in each solicitation and resultant contract, by contract clause, exhibit or specification reference, appropriate requirements for the contractor's control of quality for the supplies or services to be procured.

Contract Administration Office

Except as otherwise specified in the contract, the contract administration office cognizant at a plant is responsible for the performance of Government procurement quality assurance actions. The contract administration office shall verify that the contractor has fulfilled contract quality requirements. It is the contract administration office responsibility to develop and apply effective and efficient procedures for Government procurement quality assurance. The contract administration office shall perform specific Government inspection actions when these actions are required in writing by the purchasing office.

Part 3 - Contract Provisions

Quality Assurance Clauses

The appropriate clauses referenced in DAR 14-101.1 and (a), (b) and (c) below shall be inserted in contracts other than those entered into by use of DD Form 1155, Order for Supplies and Services/Request for Quotations.

(a) Standard Inspection Clauses. Where inspection is sufficient to assure that the supplies and services conform to contract requirements (see DAR 14-101.2), the appropriate standard inspection clause prescribed in the listing below shall be inserted in the contract:

(1) 2-103.24 and 7-103.5(a), (b) or (c);
(2) 7-203.5(a);
(3) 7-302.4(a) or (b);
(4) 7-402.5(a) (1) or (3)
(5) 7-402.5(b);
(6) 7-602.10(a);
(7) 7-602.11;
(8) 7-702.6;
(9) 7-703.6;
(10) 7-704.8;
(11) 7-901.21; or
(12) 7-1902.4 or 1-1909.5.

(b) Inspection System Requirements. When the technical requirements of the contract are such as to require control of quality by in-process as well as final end item inspection, including control of such elements of the manufacturing process as measuring and testing equipment, drawings and changes, inspection, documentation, and records, the appropriate inspection system clause listed below, referencing the latest revision of MIL-I-45208, shall be used:

(1) 7-103.5(a), (b) or (c); 7-103.24 and 7-104.33;
(2) 7-204.5(a) and (b);
(3) 7-302.4(a) or (b) and (c);
(4) 7-402.5(a) (1) or (3) and (c);
(5) 7-402.5(b) and (c);
(6) 7-602.10(a) and (b);
(7) 7-703.44; or
(8) 7-901.21 and 7-901.25.

(c) Quality Program Requirements. When the technical requirements of the contract are such as to require control of work operations, in-process controls, inspections and tests, as well as attention to other factors (e.g., organization, planning, work instructions, documentation control, advanced metrology), the appropriate clause listed below, referencing the latest revision of MIL-Q-9858, shall be used. This paragraph does not apply to construction contracts.

(1) 7-103.5(a), (b) or (c); 7-103.24 and 7-104.28;
(2) 7-203.5(a) and 7-204.10;

(3) 7-302.4(a) or (b) and 7-303.15;
(4) 7-402.5(a) (1) or (3) and 7-403.15;
(5) 7-402.5(b) and 7-403.15; or
(6) 7-901.21 and 7-901.26.

Places of Performance of Government Procurement Quality Assurance Actions

Each contract shall designate the place or places where the Government reserves the right to perform those procurement quality assurance actions that it considers necessary to determine that supplies and services conform to contract requirements. Where the contract provides for Government procurement quality assurance actions at source, the place or places designated for such actions may not be changed without authorization of the contracting officer.

Government Procurement Quality Assurance At Source

(a) When a contract requires the contractor to establish and maintain an inspection system or a quality program in accordance with 14-101.3 or 14-101.4, Government procurement quality assurance actions generally shall be performed at source.

(b) In addition to (a) above, Government procurement quality assurance actions shall be performed at source where:

(1) performance of such actions at any other point would require uneconomical disassembly or destructive testing;

(2) special instruments, gauges, or facilities required for performance of such actions are available only at source;

(3) performance of such actions at any other point would destroy or require the replacement of costly special packing and packaging;

(4) Government procurement quality assurance during performance is essential.

(c) Where the contract provides for the performance of Government procurement quality assurance actions at source, these actions shall be taken at such times and places (including any stage in the manufacturing process at both the contractor's and his subcontractor's plants) as may be necessary to determine conformance to contract requirements.

Government Procurement Quality Assurance at Destination. Government procurement quality assurance actions that can be performed at destination are normally limited to inspection of supplies. For many procurements, such inspection by the Government is sufficient. Supplies shall be inspected by the Government at destination when:

(1) they are purchased "off-the-shelf" and do not require technical inspection or no direct contract quality requirement is specified;

(2) necessary testing equipment is located only at destination;

(3) otherwise determined to be in the best interest of the Government.

Acceptance of Supplies or Services

(a) Acceptance of supplies or services is the responsibility of the activity to which the function is assigned by the purchasing office. When a Government activity uses services of another Government activity or department for the purpose of acceptance, acceptance by the other activity or department is binding upon the activity for which the services are performed. Unless there are valid reasons to the contrary, acceptance shall be at origin.

(b) Depending upon the provisions of the contract, acceptance may be effected prior to, at the time of, or after delivery. Acceptance shall ordinarily be evidenced by execution of an acceptance certificate on the applicable inspection and receiving report form (DD Form 250, DD Form 1155, or S' - dard Form 44). When acceptance is accomplished at a point other than des a-tion, supplies cannot be reinspected at destination for acceptance purpos However, such supplies should be examined at destination for identity, da' e in transit, quantity and condition.

Place of Acceptance. Each contract shall specify the place of acceptance contract which provides for Government procurement quality assurance actions only at source shall ordinarily provide for acceptance at source. A contract which provides for performance of Government procurement quality assurance actions at destination shall ordinarily provide for acceptance at destination.

Government Procurement Quality Assurance Actions on Small Purchases

(a) In determining the type and extent of Government procurement quality assurance actions to be required on small purchases, the criticality of application of the item, the amount of possible losses, and the likelihood of uncontested replacement of defective supplies shall be considered.

(b) Government procurement quality assurance of small purchases shall be at destination, unless the provisions of DAR 14-305.2(a) or (b) apply. Government procurement quality assurance actions shall be performed at source if defective supplies can harm personnel or equipment. In such case, one of the types of contract quality requirements described in DAR 14-101 shall be included in the contract.

(c) Unless detailed Government procurement quality assurance actions are necessary, inspection of small purchases shall consist of examination of:

(1) type and kind;
(2) quantity;
(3) condition;
(4) operability, if readily determinable;
(5) preservation, packaging, packing and marking, if applicable.

Part 4 - Government Procurement Quality Assurance Actions

General

This Part sets forth policies and procedures for performance of Government procurement quality assurance actions by contract administration offices, designed to provide a systematic product-oriented plan, appropriate distribution of effort, and maintenance of suitable records.

Planning

(a) Government procurement quality assurance actions to determine a contractor's compliance with contract quality requirements shall be systematically planned, taking into consideration the relative importance of the product and the variety of tasks required of the available resources. Systematic planning shall include:

(1) review and analysis of pre-award surveys, post-award conferences, technical data packages, and first article approvals;

(2) identification of the specific products, processes and procedures to be subjected to Government procurement quality assurance as well as the specific characteristics of such products, processes, or procedures to be verified;

(3) provisions for effective distribution and utilization of the Government's efforts and resources between inspection of products and inspection of the contractor's methods of regulating quality; and

(4) provisions for keeping and using records.

(b) Planning to determine the extent of Government procurement quality assurance actions shall include as a minimum:

(1) possible effect of failure on the health or safety of personnel, or on associated or related equipment;

(2) tactical, strategic, or technical importance;

(3) complexity and the need for required reliability;

(4) pertinency, completeness, and reliability of the contractor's quality records;

(5) previous quality history of the contractor; and

(6) unit cost.

Implementation

(a) Determination of conformance to contract quality requirements shall be made on the basis of objective evidence of quality. In determining the acceptability of supplies or services, the contract administration office shall make optimum use of quality data generated by contractors. To the extent that contractor quality data are available and reliable, as determined by the contract administration office, such data shall be used to adjust the amount of Government procurement quality assurance to a minimum consistent with proper assurance that the supplies or services accepted conform to contract quality requirements.

(b) When the contract requires the contractor to conduct particularly expensive tests involving destruction of supplies, extended periods of time for conducting the tests, or other factors contributing to high-testing costs, the tests shall be coordinated between the contractor and the Government to the maximum extent practicable to avoid the need for later independent Government examination and testing.

(c) The following basic actions shall be taken to determine the contractor's compliance with the contract quality requirements:

(1) review and evaluation of the contractor's inspection procedures;

(2) review and evaluation of the contractor's selection, calibration, maintenance, and use of gauges and measuring and test equipment;

(3) review and evaluation of the contractor's quality records; and

(4) performance of product verification inspection by the Government.

(d) Because of configuration, innumerable design characteristics, and life and reliability requirements, the quality of complex supplies and equipment cannot be adequately evaluated by inspection only; such supplies and equipment must be produced under regulated conditions if adequate assurance of product quality is to be realized. Systematic control of manufacturing processes by the producer is an essential prerequisite for assuring the quality of such items. It is also essential that the Government verify systematically that such control is, in fact, established and maintained by contractors.

Nonconforming Supplies and Services

(a) It is the policy of the Government that supplies or services which do not conform in all respects to the contract requirements should be rejected. Ordinarily, they will be rejected when the failure to conform adversely affects one or more of the following major areas: (1) performance, (2) durability, (3) reliability, (4) interchangeability, (5) effective use or operations, (6) weight or appearance (where a factor), (7) health or safety. However, there may be circumstances (e.g., reasons of economy or urgency) when acceptance of such nonconforming supplies or services is in the interests of the Government. Except as provided in (d) below, final decision for acceptance shall be made by the procuring contracting officer based on information

furnished by the contract administration office. The information shall include:

(1) information explaining in what respect the supplies or services fail to conform to the contract requirements;

(2) if feasible, a request from the contractor for acceptance of the supplies or services;

(3) reasons for recommending acceptance or rejection of the supplies or services offered; and

(4) if acceptance is recommended, what adjustment is deemed appropriate or has been offered by the contractor (if known).

The procuring contracting officer shall, in appropriate cases, obtain the concurrence of the military activity responsible for the technical requirements. In addition, where health factors are involved, concurrence shall also be obtained from the Surgeon General of the Military Department concerned.

(b) Contractors ordinarily shall be given an opportunity to correct or replace nonconforming supplies or services if this can be done within the required delivery schedule. Unless the contract provides otherwise, such correction or replacement shall be made without additional cost to the Government. Paragraph (c) of the standard Inspection clause in 7-103.5(a) reserves to the Government the right to charge the contract the cost of Government reinspection and retests because of prior rejection.

(c) When nonconformance of supplies or services is minor in that it does not affect (1) performance, (2) durability, (3) reliablity, (4) interchangeability, (5) effective use or operation, (6) weight or appearance (where a factor), or (7) health or safety, the contract administration office shall make the determination regarding the acceptance or rejection of such nonconforming supplies or services, except when authority to do so is withheld by the procuring contracting officer. The contract administration office may establish a joint contractor-contract administration office Material Review Board to assist in making this determination. Acceptance of nonconforming supplies which affect (1) performance, (2) durability, (3) reliability, (4) interchangeability, (5) effective use or operation, (6) weight or appearance (where a factor), or (7) health or safety is outside the scope of Material Review Board disposition and must be handled as specified in (a) above.

(d) Each contract under which nonconforming supplies or services are accepted under (a) above shall be modified to provide for an equitable price reduction or other consideration. In the case of minor nonconformances, as discussed in (d) above, the contract shall not be modified, except when it appears to the contract administration office that the savings to the contractor in fabricating the nonconforming supplies or performing the nonconforming services exceed the administrative cost to the Government of processing a contract modification (normally $50), or the best interests of the Government otherwise require that the contract be modified.

APPENDIX D

CONFIGURATION MANAGEMENT REQUIREMENTS FOR FULL-SCALE DEVELOPMENT

NOTE: While this Configuration Management Requirements Document originally was prepared for a major NAVSEASYSCOM full-scale development program (see Paragraph 3.1.12.6), its principles apply, nonetheless, to other Navy programs. Also, while this document relates to both hardware and computer software it may be incomplete as regards computer software. For further information regarding computer software Configuration Management it is suggested that the NOSC Project Office contact the Software Quality Control Branch, Code 9133. Should additional information regarding Configuration Management Requirements for hardware development be desired, it is suggested that the Product Assurance Division, Code 931, be contacted.

CONTENTS

(NAME) SYSTEM

CONFIGURATION MANAGEMENT PLAN

1. SCOPE

This Plan establishes the elements of and procedures for the conduct of configuration management for the (name) System in the Full Scale Development phase. This development effort is being conducted under the authority of NAVSEASYSCOM with the NAVOCEANSYSCEN designated as the technical direction agent. This Plan covers configuration identification, control and accounting. Use of the configuration management information system and maintenance of the procurement documentation (drawings and specifications) are also covered.

1.1 Purpose. Within the scope of work defined in the applicable contract, this Plan establishes the configuration management requirements for the Functional and Product Baselines. As used herein, the Functional Baseline is deemed to include the (name) System Development Specification (number), Software Program Performance Specification, Interface Design Specifications and Interface and Installation Control Drawings. The Product Baseline is deemed to include the engineering drawings, associated lists, specifications (hardware and software) and all software program description documents and data base design.

2. APPLICABLE ABBREVIATIONS, ATTACHMENTS, DOCUMENTS AND FORMS

2.1 Applicable Abbreviations

CAR	Configuration Audit Review
CCB/SCCB	Configuration Control Board/Software Change Control Board
CCD	Configuration Control Desk
CDRL	Contract Data Requirement List (DD 1423)
CI	Configuration Item
CSAR	Configuration Status Accounting Report
DCAS	Defense Contract Administration Service
ECP	Engineering Change Proposal
FCA	Functional Configuration Audit
NAVOCEANSYSCEN	Naval Ocean Systems Center, San Diego
NAVSEASYSCOM	Naval Sea Systems Command
NOR	Notice of Revision
PCA	Physical Configuration Audit
TDA	Technical Direction Agent
TECH/OPEVAL	Technical Evaluation and Operational Evaluation

2.2 Applicable attachments

a. CCB ECP Assessment Form

2.3 Applicable Documents (The document issue in effect on the date of invitation of bids applies)

a.	Y32.16	Reference Designations for Electrical and Electronic Parts
b.	DOD-STD-100	Engineering Drawing Practices
c.	DOD-STD-480 Series	Configuration Control
d.	MIL-STD-130	Identification Marking
e.	MIL-P-15024	Plates and Tags for Identification of Equipment
f.	MIL-STD-1168	Ammunition Lot Numbering
g.	MIL-E-16400	Electronic and Navigation Equipment
h.	L-S-300	Sheeting and Tape
i.	MIL-P-19834	Plate Identification
j.	ANSI-Y-14.5	Geometric Dimensioning and Tolerancing
k.	MIL-STD-483	Configuration Management Practices for Systems, Equipment, Munitions and Computer Programs
l.	MIL-STD-1521	Technical Reviews and Audits for Systems, Equipments and Computer Programs

2.4 Applicable Forms

DD 1692	Engineering Change Proposal
DD 1694	Request for Deviation/Waiver
DD 1695	Notice of Revision
SF 30	Contract Change Order

3. ORGANIZATIONS, RESPONSIBILITY, AND AUTHORITY

Overall management of the (name) system is the responsibility of the NAVSEASYSCOM Project Manager (code). The NAVOCEANSYSCEN, designated as the Technical Direction Agent for the program, will assist NAVSEASYSCOM in this effort with responsibilities and authority as delegated (see Paragraphs 3.2 and 3.3).

3.1 NAVSEASYSCOM will retain overall program authority and will provide:

a. Approval of the Product Baseline (see Paragraphs 4.1.1 and 4.1.2)

b. Direction of the NAVSEASYSCOM CCB by functioning as the CCB Chairman

c. Approval of all Class I ECPs (see Paragraphs 5.1 and 5.5)

d. Approval of all critical and major deviations and waivers (see Paragraphs 5.1 and 5.5)

3.2 NAVOCEANSYSCEN, functioning as the TDA, is delegated authority and responsibility to provide:

a. Technical advice and recommendations to NAVSEASYSCOM on all elements of procurement documentation and changes thereto

b. Technical advice and recommendations to NAVSEASYSCOM in the development of the Initial and Final Product Baselines

c. Operation of a TDA CCB staffed with appropriate members, including the NAVSEASYSCOM Deputy Chairman

d. Operation of a TDA CCD keeping track of and processing all documentation and changes for the Functional Baseline

e. Concurrence with the classification of Class I and II ECPs and critical major and minor deviations and waivers

f. Following establishment of the Initial Product Baseline (Paragraph 4.1.2), the TDA will approve Class II ECPs after the DCAS has approved the Technical Content

g. Assistance to NAVSEASYSCOM in the management of this Plan at the contractor and Government establishments

h. Maintenance of Functional Baseline (i.e., that baseline which establishes the basis for full-scale development - see Paragraph 4.1.1)

3.3 Defense Contract Administration Service (DCAS) within three working days after receipt of engineering changes shall:

a. Review contractor initiated changes, and approve/disapprove the classification of ECPs, deviations and waivers

b. Approve minor deviations and waivers if so delegated by the NAVOCEANSYSCEN

c. Review contractor initiated ECPs, deviations and waivers for technical accuracy and provide recommendations to NAVOCEANSYSCEN on all elements of the change

d. Review deviations and waivers for verification of all information thereto and contractor's proposed corrective action for future production

e. Ensure accomplishment of necessary correction actions

3.4 Contractor. The contractor shall ensure that the responsibilities of the contractor's configuration management organization and its position in the overall program structure have been defined. In doing this, the contractor shall provide engineering services to support this Plan, as contractually specified providing as a minimum:

a. Configuration Management Plan. Effective with the release of engineering drawings for the purchase or fabrication of hardware for the units, the contractor shall implement configuration management for all such released drawings and specifications. Following such release and until the Initial Product Baseline (see Paragraph 4.1.2) is established the contractor shall control all changes to the affected documents (drawings, specifications) through the process of issuing internal change control documents which are the functional equivalent of ECPs, deviations and waivers. Should any such changes impact the documents forming part of the Functional Baseline, the contractor shall initiate a Class I ECP, prepared in accordance with DOD-STD-480, for submission for NAVSEASYSCOM approval prior to implementing the actual

change. Upon establishment of the Initial Product Baseline all subsequent changes to the baseline documents and to the hardware shall be documented by ECPs, deviations and waivers, prepared in accordance with DOD-STD-480, and submitted for government approval, as appropriate.

b. Configuration Identification, Control and Accounting. At the onset of the contract the contractor shall maintain a listing of the documents comprising the Functional Baseline. This listing shall reflect all Navy approved changes (ECPs) to that baseline and the dates of approval of such changes. Effective with the release of engineering drawings or specifications for the purchase or fabrication of hardware for the units, the contractor shall maintain a listing of such drawings or specifications with such listing reflecting all changes (internal change control documents and any deviations and waivers) which he has approved for the hardware. When fully expanded to include all documents and approved changes describing the hardware, this listing will become the contractor's proposed Product Baseline (see Paragraph 4.1.2) and will form the basis for the Physical Configuration Audit. Upon completing the audit and resolution of all baseline-hardware differences noted during the audit, the contractor shall annotate each entry on his listing thereby establishing the "design of record" at the time of audit. The Initial Product Baseline (see Paragraph 4.1.2) is generated with the publishing of the "design of record" documents (drawings/specifications and approved changes). Once established, the Initial Product Baseline will include all Navy approved Class I and II ECPs generated for all Configuration Items.

c. Accounting of ECPs, deviations and waivers, which are included in hardware and software submitted for Government acceptance.

d. Prepare or review proposed ECPs, deviations and waivers.

e. The contractor shall maintain complete "as built" hardware records providing serial number effectivity accounting for all internal engineering changes, for all Class I and II ECPs and for all critical and major deviations and waivers throughout the life of the contract. Serial number accounting requires the identification of the next highest serialized assembly in those instances where the affected item is not serialized.

f. Documentation of Product Baseline Configuration.

g. Support configuration audits.

h. Configuration audit reports.

4. CONFIGURATION IDENTIFICATION

Configuration identification is the establishment and documentation of the baseline of a CI as set forth in specifications, drawings and documents referenced therein. The term CI is applied to each item identified by a Government drawing. A drawing and specification tree is to be developed by the contractor within the scope of the work defined in the applicable contract. Content, format and delivery shall be in accordance with CDRL item number (specify). Serial numbers shall be provided by NAVSEASYSCOM (code) in accordance with the contract.

4.1 Baseline Descriptions. The approved documentation which delineates the functional/product and physical characteristics of a CI is called a baseline. Baselines plus approved ECPs or other changes constitute current configuration identification. Baselines shall include all applicable drawings, specifications and lists.

4.1.1 Functional Baseline. The Functional (or allocated) Baseline shall consist of the Prime Item Development Specification (number), Software Program Performance Specification, Interface Design Specifications and Installation and Interface Control Drawings which in combination define the physical and functional requirements at the system level. The Prime Item Development Specification shall be supplied to the contractor by the Government. The contractor shall be responsible for recommending via ECP any necessary changes to the development specification. The contractor shall provide the engineering services to develop the necessary Critical Item Development Specifications (MIL-STD-490, Type B2), the Software Program Performance Specifications, Interface Design Specifications and the Installation and Interface Control Drawings for the Functional Baseline. Commencing with approval by NAVSEASYSCOM (code) all changes to the Functional Baseline are subject to the configuration control requirements of this Plan. The content, format and delivery of the Software Program Performance Specifications, Interface Design Specifications and the Interface and Installation Control Drawings shall be in accordance with the CDRL.

4.1.2 Product Baseline. The Product Baseline is the output of the Full Scale Development Effort and is that baseline to which production systems ultimately will be fabricated. The Initial Product Baseline (IPB) is established following the successful completion of the functional acceptance tests and with the successful completion of the Physical Configuration Audit of the first system to be submitted for Government acceptance. Prior to such audit, however, the engineering drawings and specifications constituting the baseline should have undergone an independent technical review by the NAVOCEANSYSCEN. NAVOCEANSYSCEN will provide comments to the contractor which identify errors which are in violation of the requirements of the contract and which would ultimately preclude the government from approving the final drawing package. At the time of the audit, differences between the physical hardware and the contractor's proposed Product Baseline will be accounted for by ascertaining the existence of approved ECPs, deviations or waivers describing the differences noted. Differences noted for which approved ECPs, deviations or waivers are not apparent will be recorded by ECP or waiver, as appropriate. Therefore, at the successful completion of the Audit, the Initial Product Baseline will be established by adding to the contractor's proposed Product Baseline those ECPs describing desirable differences between the drawings and the hardware. Those differences between the drawings and the hardware which are acceptable for Navy technical evaluation but not for production, are recorded as waivers to be retained as evidence of acceptable variations between the evaluation hardware and the baseline. After completion of Navy technical evaluation, the engineering drawings and product specifications with all ECPs incorporated, including those generated as a result of Navy technical evaluation (TECH/OPEVAL) shall be submitted for formal Navy approval. Approval of the drawings and specifications will constitute approval of the Final Product Baseline, as

well. The Product Baseline for software is established by the Formal Qualifications Review (FQR) in accordance with MIL-STD-1521, before the start of Navy technical evaluation.

4.2 Configuration Item Identification. The contractor shall prepare, manufacture and install identification plates and marking labels and perform product marking, in accordance with MIL-E-16400 as modified herein. A copy of the proposed identification plate and marking label drawings shall be provided to NAVOCEANSYSCEN (code) for review and approval.

In the event of any conflict or inconsistency between referenced documents and the documents referenced herein as applied to identification plates and marking of products, this section shall take precedence.

4.2.1 Requirements

The contractor shall conform to the identification plate and product marking requirements cited herein for systems, sets, groups, units, assemblies, lower level assemblies and parts produced or procured under the contract. Nomenclature lettering (type designations and noun name) shall be at least 1/4 inch high (24 points) on all identification devices. Reference designations shall be assigned in accordance with ANSI Y32.16. Part numbers shall be assigned in accordance with DOD-STD-100. Sample identification plate and marking label formats are depicted in Paragraph 4.3 herein.

4.2.2 If the marking requirements specified herein become a problem because of space limitations or other reasons, the contractor shall document the problem and proposed solution and present it to NAVOCEANSYSCEN (code) for resolution.

4.2.3 System, Set, Group, Unit. The material and physical characteristics of identification plates for Systems, Sets, Groups and Units shall conform to general specifications of MIL-P-15024 as amended herein.

Classification:	Type A, B, or H	
Color Style:	III	
Standard Dimensions:	System or Set	- Size 9, 8, or 6
	Group	- Size 6 or 5
	Unit	- Size 5 or 4

Identification plates shall be secured by removable machine screws. Identification plates shall be located on the front of units with the set (or system) and group plates on a major contractor furnished unit. Unit plates shall be placed on each unit.

4.2.4 Assembly, Lower Assembly. Functional assemblies (i.e., items assigned assembly reference designators per ANSI Y32.16) will be marked in accordance with MIL-STD-130 as modified herein. Paragraph 4.1, "Methods of Applying" second sentence, shall be changed to read, "When these methods are not practicable, the marking shall be applied directly on the item by a marking label

conforming to the material and physical characteristics required by Federal Specification L-S-300 with the following specific requirements:

Type: I   Class: 1   Durability: L   Color: White with black letters

Paragraph 4.3, "Permanancy and Legibility," second sentence, shall be changed to read, "Legibility shall be such as required for ready readability using the colors specified for identification plates and labels in this requirement." Detailed marking information will be in accordance with Paragraph 5.2.

4.2.5 Computer Program Package Identification

a. The Computer Program package shall be identified with a part number and a reference designation relating the Program Package to the unit. The deliverable computer program package and carrier case (if used) shall be marked in accordance with the content and format requirements identified in Figure 4.5 using the reference designated as the unit number. Both the package and carrier case (if used) shall be marked using an identification plate conforming to the material and physical characteristics of MIL-P-19834, Type II, Style II. The identification plate size and format may vary as necessary to accommodate space limitations.

b. The computer program package (DI-S-2141) shall be clearly marked at the level of the lowest removable component (magnetic tape, magnetic cassette, containers, reads, etc.) to reflect the appropriate (name) System Product Baseline Computer Program.

4.3 Identification Plates Contents and Formats

See Figures 4.1, 4.2, 4.3, 4.4, 4.5.

4.3.1 System or set identification plate content and format for a system or set that is not compromised of groups shall be in accordance with Figure 4.1. A system or set consisting of two or more groups will require a two part identification plate in accordance with Figure 4.2. The lower identification plate of Figure 4.2 may be prepared as marking label per Paragraph 4.2.3.

4.3.2 Group. Identification plate content and format for the CFE group shall be in accordance with Figure 4.3.

4.3.3 Unit. Identification plate contents and format for CFE units shall be prepared in accordance with Figure 4.4.

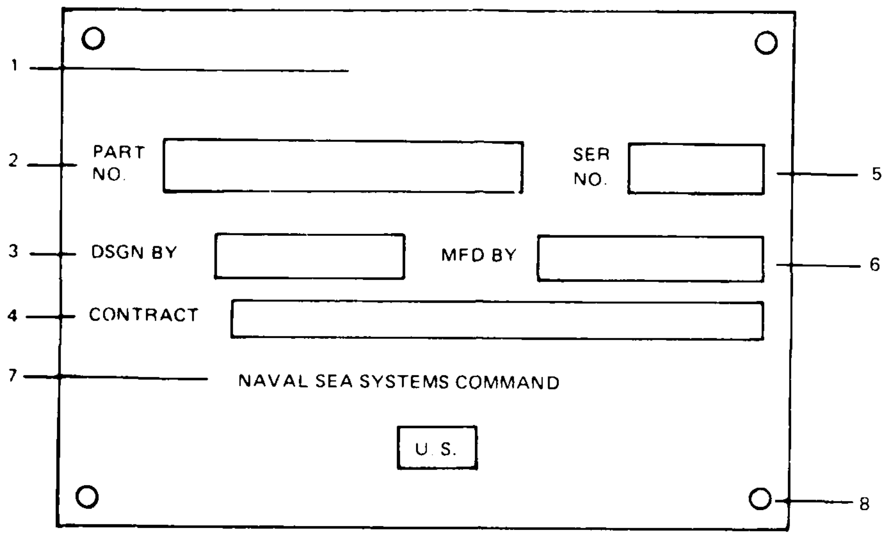


Figure 4.1. System or set nameplate – sample.

1. Insert the system/set approved nomenclature (type desig. and noun name)
2. Insert the system/set part number from system top drawing
3. Insert the design activity code in identification number
4. Insert the contract number under which the system/set is being produced
5. Insert governmental serial number for the system/set
6. Insert the manufacturer's code identification number
7. Insert the name of the organization the system/set was manufactured
8. Only removable type machine screws to be used

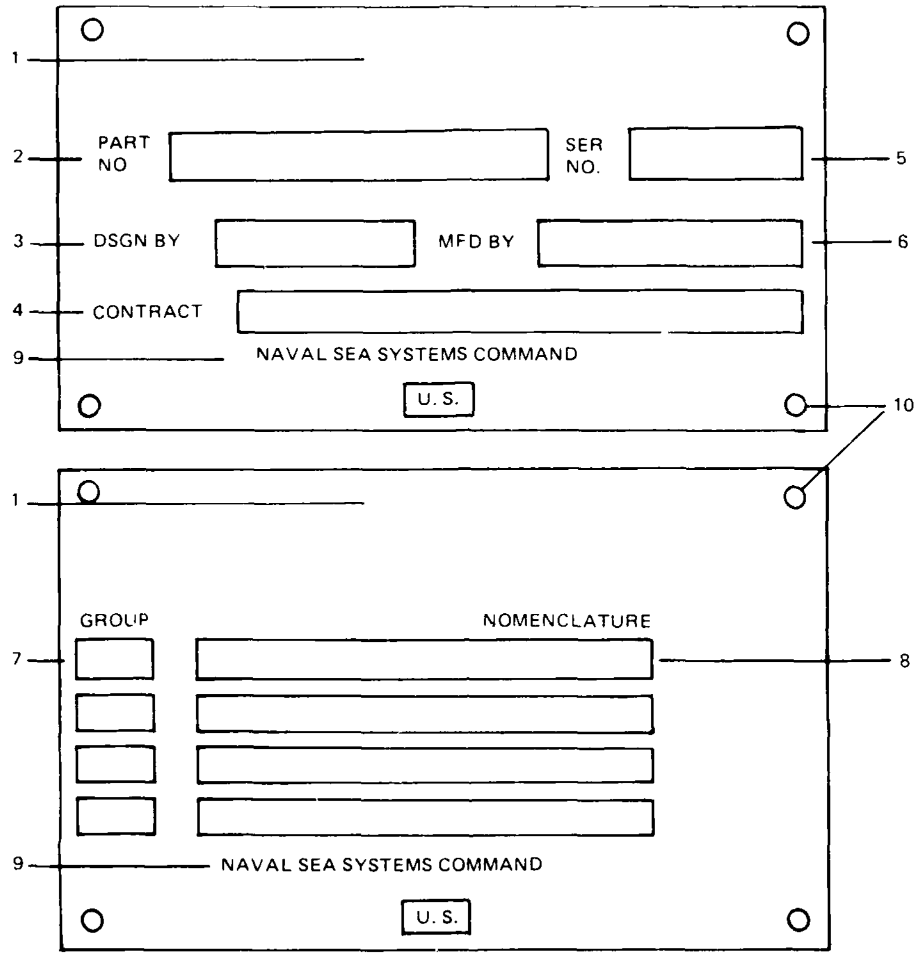


Figure 4.2. Group, system or set nameplate – sample.

1. Insert the system/set approved nomenclature (type desig. and noun name)
2. Insert the system/set part number from system top drawing
3. Insert the design activity code identification number
4. Insert the contract number under which the system/set is being produced
5. Insert government serial number for the system/set
6. Insert the manufacturer's code identification number
7. Insert the group identification letter
8. Insert the group nomenclature (type desig. and noun name)
9. Insert the name of the organization the system/set was manufactured for
10. Only removable type machine screws to be used

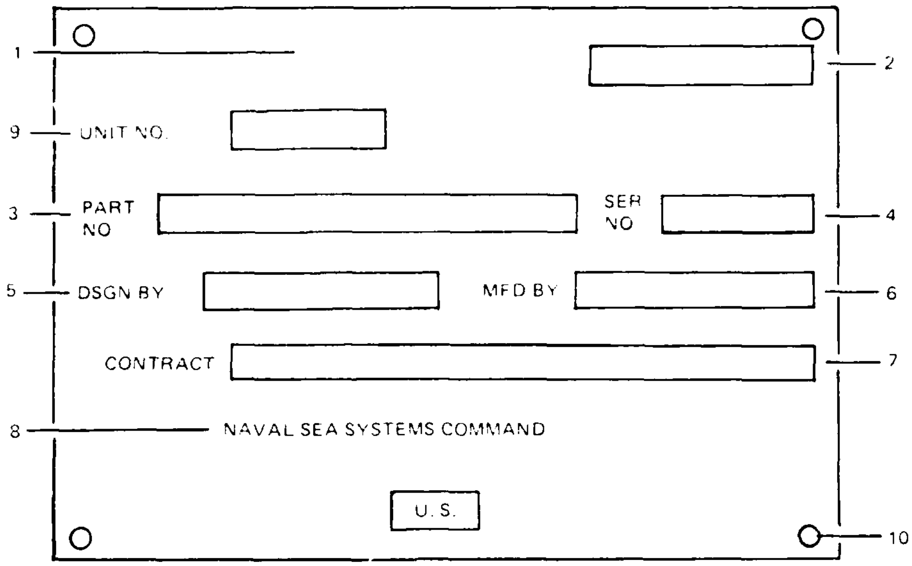


Figure 4.3. Group nameplate – sample.

1. Insert the group approved nomenclature (type desig. and noun name)
2. Insert the group assignment letter
3. Insert the group part number
4. Insert the governmental serial number for the group
5. Insert the design activity code identification number
6. Insert the manufacturer's code identification number
7. Insert the contract number under which the group is being procured
8. Insert the name of the organization the group was manufactured for
9. Insert unit number when group consists of a single unit
10. Only removable type machine screws to be used

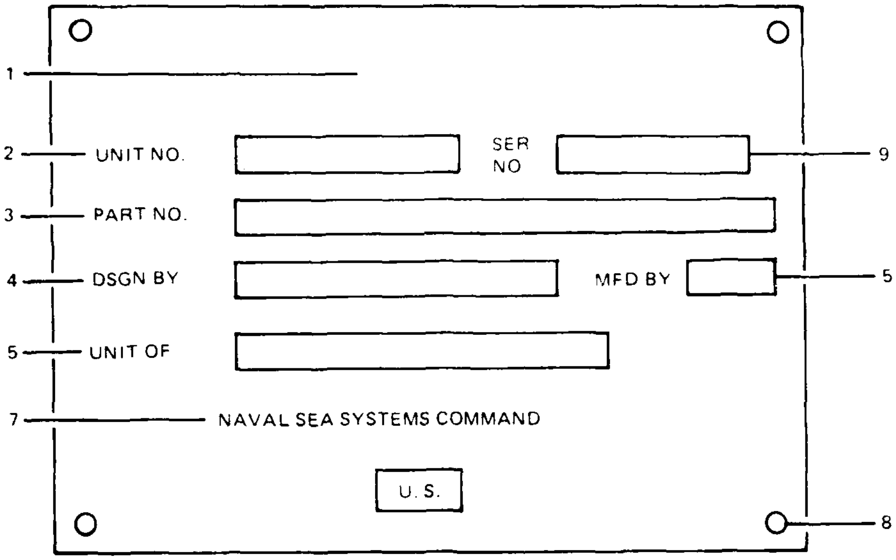


Figure 4.4. Unit nameplate – sample.

1. Insert unit name (noun name and type desig.)
2. Insert unit number
3. Insert the unit part number
4. Insert the design activity code identification number
5. Insert the manufacturer's code identification number
6. Insert the type designation of system or set
7. Insert the name of the organization unit was manufactured for
8. Only removable type machine screws to be used
9. Insert the unit serial number

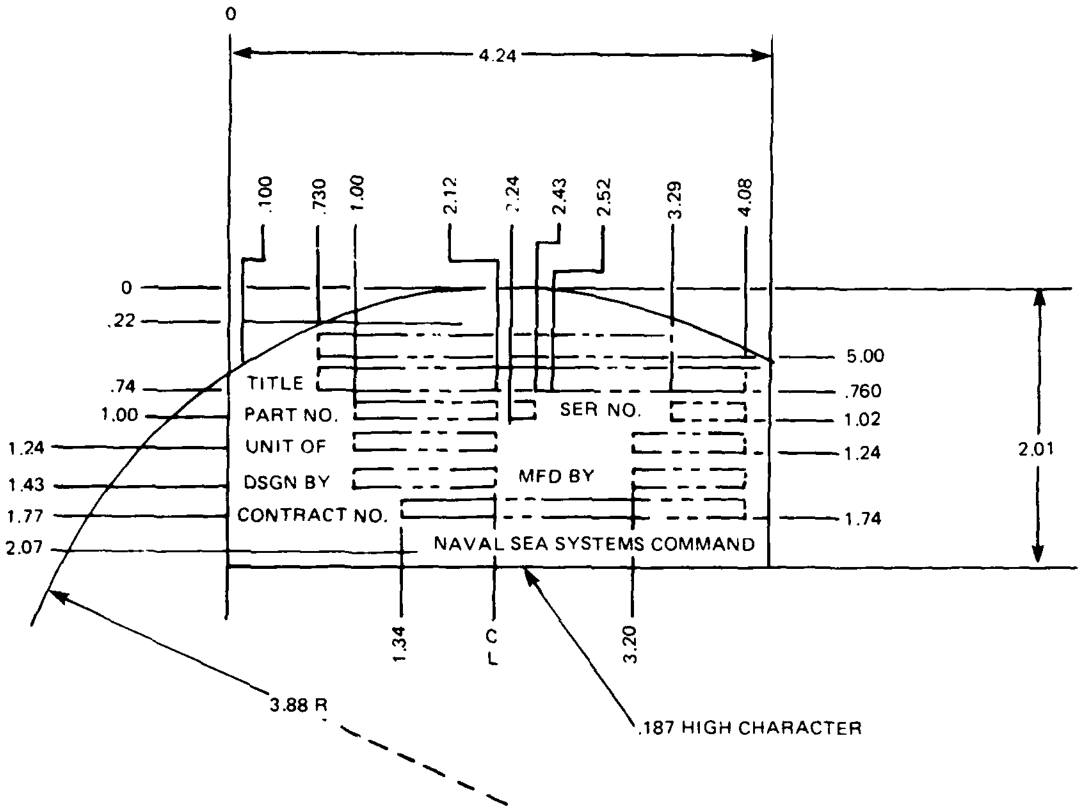


Figure 4.5. Computer program label – sample.

NOTES:

1. Plate to be type II per MIL-P-19834.
2. Material: Alum foil conforming to type 114S-119-DP SAE STD AMS 7292.
3. MIL-STD-130 applies for permanency and legibility.
4. Unless otherwise specified characters to be .12 high gothic style sans serif.
5. Unless otherwise indicated all characters shall be located systematically about centerline of plate.

5. CONFIGURATION CONTROL

Essential to configuration management is the timely exercise of configuration control which will be applied in accordance with DOD-STD-480 with due consideration for all technical, contractual and logistic aspects of the (name) System. Configuration control as described herein shall include hardware as well as computer software (programs, firmware and data bases) as individual configuration items. Computer software ECPs shall be subject to the same management controls as hardware configuration items.

5.1 The departures from the baselines are ECPs, deviations and waivers as defined and categorized in DOD-STD-480. These are Class I and II ECPs and critical, major and minor deviations and waivers.

5.2 Changes to the Functional Baseline. All proposed changes to the Functional Baseline shall be submitted as Class I ECPs or critical or major deviations and waivers.

5.3 Changes to the Product Baseline. Changes to the Product Baseline including the Initial Product Baseline shall be as defined in Paragraph 5.1.

5.4 The control process shall use the forms of DOD-STD-480 for ECPs, deviations and waivers, as described herein. These shall be submitted in accordance with CDRL item number (specify) for government approval.

5.4.1 Class I ECPs shall use pages 1, 3 and 4 as shown in DOD-STD-480 (Form DD-1692, DD-1692-2 and DD-1692-3).

5.4.2 Class II ECPs shall use only page 1 (Form DD-1692) of the ECP shown in DOD-STD-480.

5.4.3 All document changes shall be described on the Notice of Revision (NOR) Form DD-1695 in accordance with DOD-STD-480.

5.4.4 All waivers and deviations will be described on Form DD-1694 of DOD-STD-480. All waivers will show proposed corrective action.

5.4.5 All ECPs and all critical and major deviations and waivers shall provide serial number effectivity information.

5.5 The approval/disapproval of proposed Class I ECPs and critical and major deviations and waivers is the function of the NAVSEASYSCOM CCB coordination with the NAVSEASYSCOM Project Manager.

5.5.1 The contractual implementation of approved ECPs, deviations and waivers that affect the contract cost or schedule will be by the authority of the NAVSEASYSCOM Contracting Officer or his designee.

5.5.1.1 Class I ECPs or critical and major deviations affecting the contract cost or schedule will be implemented by use of a Contract Change Order (SF 30) issued by NAVSEASYSCOM Contracting Officer.

5.5.1.2 Class I and II ECPs, major and minor deviations and waivers which do not affect cost or schedule will be implemented by a bilateral agreement between the Government and the contractor.

5.5.2 The NAVSEASYSCOM CCB shall have the following membership:

(List Members)

5.5.2.1 Subordinate CCBs shall be established at the NAVOCEANSYSCEN and at the contractor's facility to provide a thorough contractual and/or technical review of departures from the baselines. Each CCB will establish a CCD through which all actions will flow and at which a complete accounting and status of all actions will be maintained.

5.5.2.1.1 The NAVOCEANSYSCEN CCB Chairman will be responsible for the conduct of all actions not specifically requiring the approval of the NAVSEASYSCOM CCB Chairman.

5.5.2.2 If so delegated by the NAVOCEANSYSCEN, minor deviations and waivers will be approved by DCAS at the contractors plant. In the event of such delegation, copies of all such actions approved by DCAS shall be forwarded to NAVOCEANSYSCEN.

5.6 The goal for reaching a decision (approval/disapproval) regarding Class I ECPs and critical and major is: deviation and waivers.

Emergency	24 hours
Urgent	15 days
Routine	30 days

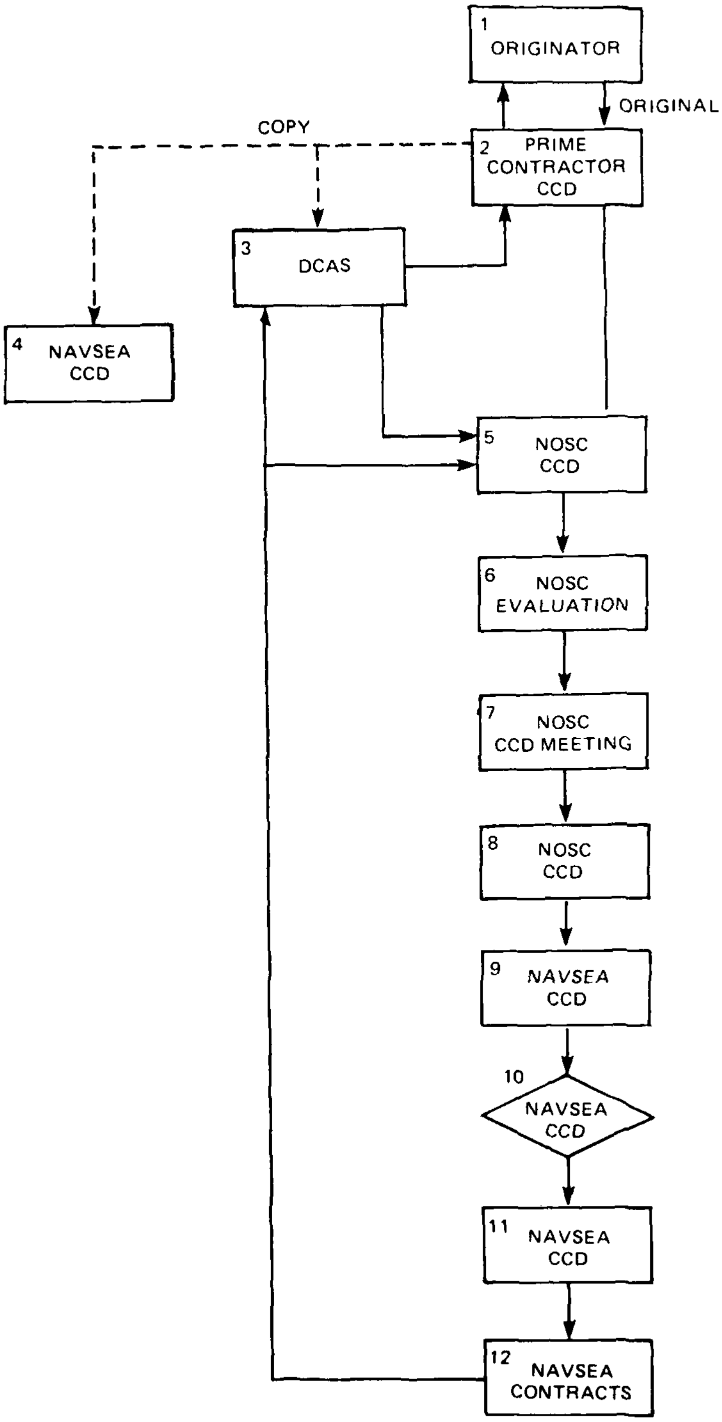
The flow of approval/disapproval action is shown in Figures 5.1 and 5.2.

5.7 The cost shown on an ECP will be all costs associated with the initiation, preparation and implementation of the change and will be the basis for categorization in Paragraph 5.5.1. These costs will be a firm maximum price (not an estimate) for a 60 day period from the date of the ECP submittal to the DCAS for review. All costs will be supported by categorized labor hours and materials costs and will be readily traceable.

5.8 Changes which introduce non-interchangeable conditions in the configuration items will require a new identification (different drawings or specifications) in accordance with DOD-STD-100.

6. CONFIGURATION STATUS ACCOUNTING

Configuration status accounting is defined as the recording and reporting of: (1) the approved configuration identification; (2) the status of proposed and approved changes to that configuration identification; and (3) the effectivity of the incorporation of the approved changes into the delivered hardware or software.



1. Originate ECP, Deviation/Waiver

2. a. Record and review for technical accuracy
   b. Distribute for review

3. a. Review for proper classification
   b. Provide comments to NOSC
   c. Review ECP, Deviation/Waiver for verification of corrective action

4. a. Record and distribute
   b. PMS 4078 to provide comments to NOSC if applicable

5. a. Record
   b. Review for priority and classification
   c. Review for completeness
   d. Prepare distribution list
   e. Distribute for review
   f. Establish data for return of comments and/or data for CCD meeting

6. Sponsor shall review and prepare assessment form that includes detailed comments from: Engr/design (lead engr), interface, CM, documentation, prog. plans, cost/schedule, performances, and effectivity

7. a. Compile comments as required
   b. System Engr. and Members analyze and recommend approval/disapproval

8. a. Record results of CCD meeting
   b. Forward CCD, assessment sheet, Deviation or Waiver

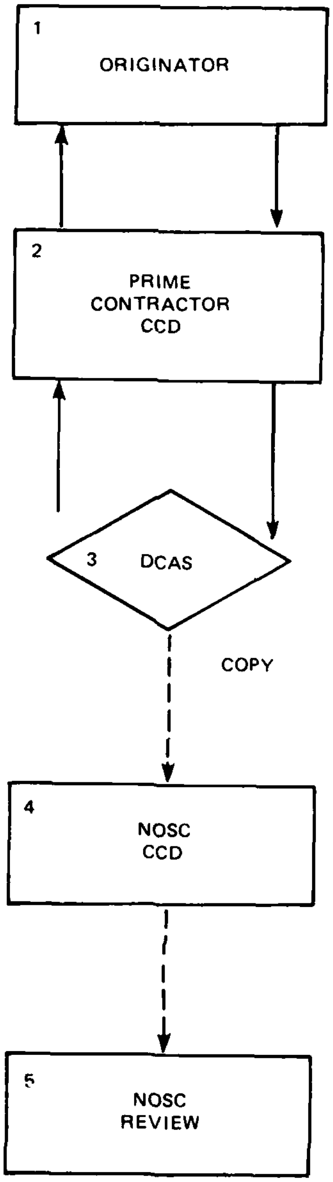
9. Record and distribute to PMS 407

10. a. PMS 407 evaluate and recommend
    b. CCD approves/disapproves

11. Forward CCD, Deviation or Waiver

12. a. Issue/delegate implementation by contract Mod
    b. Forward approve/disapprove ICP, Deviation or Waiver

Figure 5.1. Flow of Class I ECPs and critical and major DEV/WAV.



1. Originate ECP, Deviation/Waiver

2. Record and review for technical accuracy

3. a. Evaluate and approve/disapprove
   b. Send copy to NOSC, CCD

4. Record and distribute to NOSC lead engineers

5. Review for concurrent of classification

Figure 5.2. Flow of Class II ECPs and minor DEV/WAV.

6.1 "As Built" Configuration Data List. The contractor shall provide "as built" data for each CI offered for acceptance by the Government. The content, format and delivery of the "as built" data list shall be in accordance with the CDRL item number (specify).

6.2 Configuration Listing. The Configuration Listing shall identify all piece parts, non-functional and functional assemblies that make up the complete system. It shall document the Product Baseline Configuration and the Current Contractual Configuration. It represents the approved configuration of the first system to be accepted for delivery by the Government. The Current Contractual Configuration is the latest approved hardware/software configuration and is equivalent to the Product Baseline Configuration plus all approved changes thereto. The content, format and delivery of the configuration listing shall be in accordance with CDRL item number (specify).

6.3 Configuration Status Accounting Report (CSAR). Commencing with contract award, all Class I ECPs and critical and major deviations and waivers to the Functional Baseline shall be documented in the applicable sections of the CSAR. Upon establishment of the Initial Product Baseline, (see Paragraph 4.1.2) all Class I ECPs, Class II ECPs and critical and major deviations and waivers, thereto shall also be documented in the applicable sections of the CSAR.

In addition to changes, the CSAR shall document the Government serial number of each serialized CI delivered.

The content, format and delivery of the CSAR shall be in accordance with CDRL item number (specify).

7. CONFIGURATION AUDITS AND REVIEW REQUIREMENTS

7.1 Configuration Audits Requirements. To establish the initial Product Baseline and validate that CIs have been developed satisfactorily, a Configuration Audit Review (CAR) will be performed. At the completion of acceptance testing, the contractor shall propose, for government approval, the CI to be audited. The CAR will consist of functional and physical audits performed on the equipment.

While the end product of the CAR is expected to be validated technical documentation, the audits are not intended to be the sole basis for such validation. The local Government representative is responsible for continuing surveillance of the contractor's quality assurance practices before, during, and after CAR; in effect, this constitutes a continuous audit of the contractor's manufacturing operations. The audit plan shall be documented in accordance with CDRL item number (specify) and shall be submitted for government approval.

7.1.1 The Functional Configuration Audit (FCA). The FCA is defined as the formal examination of functional characteristics' test data for a configuration item, prior to acceptance, to verify that the item has achieved the performance specified in its functional configuration identification.

The FCA shall be conducted in accordance with the inspection and acceptance provisions of the contract. The audit agenda/findings shall be documented in accordance with CDRL item number (specify) and shall be submitted for government approval.

7.1.2 The Physical Configuration Audit (PCA). The PCA will verify the contractor's proposed Product Baseline documentation and acceptance procedures with the formal examination of the "as built" configuration of a CI. The level of the audit will be such that the individual audits of lower level elements (modular/replaceable assemblies) shall be accomplished in a manner as to make all assemblies visible for audit. Disassembly to a lower level shall be at the option of the Audit Team Chairman. The audit may be performed on assemblies of the selected CI or identical assemblies at the discretion of the Government. The PCA is accomplished subsequent to the Functional Audit. The PCA shall be in accordance with the following paragraphs.

a. Prior to beginning the PCA, the contractor shall certify that the FCA was completed and approved by the Government.

b. The contractor shall make the necessary arrangements for the Government to conduct the PCA at the contractor's factory. This shall include: the services of the required contractor personnel, to disassemble equipment as may be required, to trace incorporation of ECPs, deviations and waivers and to record hardware and documentation differences, engineering drawings in the form of microfilm aperture cards or copies with an index listing, an adequate number of portable aperture card viewers, and sufficient quantities of the current Configuration Listings (Paragraph 6.2) for use by the audit team members and a "difference package," Paragraph 7.1.2(d), to support interim changes during audit.

c. The contractor shall prepare a Configuration Audit Agenda/Report in accordance with CDRL item number (specify). The agenda defines information necessary for conducting the PCA and the report describes the proposed detailed results of the PCA.

d. While the PCA is being conducted on the system, there shall be a moratorium on initiating new changes. All changes in the process of being incorporated into the drawing or the system shall be presented to the audit team as the "difference package."

e. The audit team will consist of Government and contractor personnel. The audit team will be chaired by the NAVSEASYSCOM project representative or his designated representative.

f. The team chairman shall have the authority to:

(1) Recommend acceptance of the equipment and its documentation and approval of the Configuration Listing subject to the conditions/agreements of the audit

(2) Recommend rejection of the equipment and its documentation and disapproval of the Configuration Listing

Reasons for rejection and disapproval shall be fully documented by the audit team with the specific deficiencies noted for further NAVSEASYSCOM review.

g. The total time required to conduct the audit shall not exceed 15 working days, excluding administrative effort. The level of the audit shall be such that disassembly of the hardware may not be required, but removal of modular/replaceable assemblies shall be required to make visible all assemblies for audits. Disassembly to a lower level shall be at the option of the Audit Team Chairman. The audit will consist of a comparison of the hardware with the baseline documentation including the applicable listed engineering drawings and approved changes.

h. Any difference observed between the hardware and the baseline documentation shall be considered a potential discrepancy. However, in recognition that there may be allowable differences between the single set of drawings and a given serial numbered production unit (e.g., a change not affecting functional, mechanical or electrical interchangeability which is made effective on serial numbered units later than the one being audited), the contractor shall be given the opportunity to prove to the audit team that any potential discrepancy is in fact an allowable difference and, therefore, not a discrepancy. If the audit team membership concurs, then the potential discrepancy shall be omitted from the audit work sheet.

i. In the event that the audit should incidentally disclose a workmanship problem as opposed to a difference between hardware and baseline documentation, the problem shall be documented and referred to the Government's acceptance agency (DCAS) for handling in the normal manner.

j. Upon completion of the audit, the contractor shall prepare a final updated Configuration Listing which shall be submitted as part of the audit report (Paragraph 7.1.2(c)) above. It will differ only in that it will incorporate any and all changes required as a result of audit. Such changes shall be appropriately identified.

k. The Initial Product Baseline (see Paragraph 4.1.2) shall be considered established upon: (1) completion of the FCA; (2) completion of the PCA; (3) mutually agreeable resolution of discrepancies revealed during the audit; and (4) acceptance of the Product Baseline system/unit under this contract. The Final Product Baseline will be established at the conclusion of contractor factory acceptance testing and at the conclusion of incorporation of those changes resulting from Navy Technical Evaluation (TECH/OPEVAL) when the system drawings and specifications are approved.

7.2 <u>Configuration Review Requirements</u>. The local Government representative shall be responsible for surveillance of the contractor's configuration management system to assure compliance with contractual requirements. The local Government representative will be concerned with configuration identification through surveillance of the contractor's quality assurance program and drawing release system during the period of contract performance and especially at time of conducting the PCA.

8. PROCUREMENT DOCUMENT MAINTENANCE

The baseline documents (drawings, specifications, etc.) will be maintained in an up-to-date condition in accordance with the latest approval revisions.

8.1 THE NAVOCEANSYSCEN will maintain custody of the (name) System Development Specification (number) and of the interface and installation control drawings.

8.2 The contractor will maintain custody of and provide maintenance for the Software Program Performance Specification, Interface Design Specification and all the drawings, associated lists and specifications which make up the Product Baseline. The contractor shall transfer custody of these documents to the Navy at the time of approval of the Final Product Baseline.

8.3 The contractor shall distribute aperture cards and/or full size prints of the documentation in their custody on an as-requested basis. The distribution requirements shall be determined at a later date.

9. SUBCONTRACTOR CONFIGURATION MANAGEMENT REQUIREMENTS

Unless specific exceptions are made herein, the procurement of the subcontract items (hardware and support documentation) shall be the responsibility of the prime contractor in the performance of specific contract requirements. Accordingly, the contractor shall determine and place the necessary CM requirements on his subcontractors.

10. PARTS AND MATERIALS SELECTION, CONTROL AND IDENTIFICATION PROGRAM

The contractor shall establish a parts and materials selection, control and identification program including the following:

a. The parts and materials selection and control segment of the program shall provide for:

(1) Establishment of a parts control program meeting the requirements of MIL-STD-965, Procedure I. The selection of parts to be utilized in the design shall be in accordance with a Navy approved Program Parts Selection List (PPSL) based on suitable application and qualification to specified requirements using available reliability data. The order for selection of standards and specifications for parts and materials shall be in accordance with MIL-STD-143, with full consideration of the specified performance, qualification, reliability, safety and configuration management requirements. As a minimum, passive electronic components shall be selected from Established Reliability (ER) military specifications and shall have an ER failure rate of "P" or better (i.e., R, S or T). Additionally, discrete semiconductors shall be MIL-S-19500 level "JANTX" or better (i.e., JANTXV or JANS) and microcircuits shall be MIL-M-38510 Class "B" or better (i.e., S). Standard electronic modules, in accordance with MIL-STD-1378, shall be used in all new design applications.

The PPSL shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval. Parts not included in the PPSL

may not be used without specific Navy approval of a nonstandard parts request prepared in accordance with CDRL item number (specify).

(2) Maximum use of previously qualified parts and materials.

(3) Establishment of a parts derating policy meeting the requirements of NAVSEA 0967-LP-597-1011 and the performance of circuit element stress analysis to verify compliance with that derating policy.

(4) Adequate testing requirements with inclusion of appropriate inspection and testing requirements on the engineering drawings. Particular attention regarding the inclusion of inspection and testing requirements should be given to those drawings describing parts anticipated to be procured as spare or repair parts.

(5) Minimization of the total types and numbers of parts and materials

(6) Minimum use of limited-life items

(7) Selection of parts and materials which will be readily available as long-term supply items

(8) Exclusion of toxic materials, except when specifically approved by the procuring activity

(9) Consideration of transportation, handling, storage and installation limitations

(10) Availability of multiple procurement sources

(11) Product producibility

b. A complete parts and materials identification and status list including all PPSL items shall be developed, prior to initiation of detailed design, for use in parts and materials selection. The list, which shall be maintained and updated throughout the development phase, shall contain the following:

(1) Item identification by generic name, government and subcontractor part numbers, national stock number where applicable or a government or industry standard in the case of a material or process

(2) Qualification status, including how qualified (e.g., test, analysis, established reliability part)

(3) Identification of standard parts (authorized for use by Navy approval of the PPSL) and identification of nonstandard parts showing specific Navy authorization for nonstandard parts use

(4) Identification of limited-life items

(5) Identification of subcontractors as recommended by the designer for possible inclusion on the approved source list

(6) Identification of proprietary and sole-source parts and materials

c. A system shall be established and maintained for collecting and disseminating information such as:

(1) Approved circuits

(2) Approved parts lists

(3) Results of products qualification and engineering tests

(4) Reliability reports regarding usage and failure rates

This information shall be readily accessible to the design engineers and must be current, concise and accurate.

APPENDIX E

CONFIGURATION MANAGEMENT REQUIREMENTS FOR PRODUCTION

NOTE: The attached configuration management requirements clause is intended for use in a production contract wherein a SYSCOM is the designated procurement contracting officer (PCO) and NOSC is assigned a support engineering role during the term of the production effort. Should additional information regarding Configuration Management Requirements for hardware production be desired, it is suggested that the NOSC Project Office contact the Product Assurance Division, Code 931.

APPENDIX E

CONFIGURATION MANAGEMENT REQUIREMENTS FOR PRODUCTION

1. Engineering Change Proposals (ECPs) for proposed Class I and Class II Changes and their associated Notices of Revision or Specification Change Notices, and Requests for Deviations and Waivers affecting items being procured under this contract shall be prepared in accordance with DOD-STD-480 per CDRL item number (specify) and submitted in accordance with the provisions specified herein.

2. All change documents referred to in Paragraph 1 above shall be distributed by the contractor to the activities specified below, in the quantities noted:

a. Proposed Class I ECPs (submit on DD Form 1692, Page 1, and 1692-1, -2, -3, and -4):

- NAVOCEANSYSCEN, Code (number) - original and two (2) copies
- Administrative Contracting Officer (ACO) - two (2) copies
- NAV(name)SYSCOM, Code (number) - one (1) copy

b. Proposed Class II ECPs (submit on DD Form 1692, Page 1):

- NAVOCEANSYSCEN, Code (number) - original and two (2) copies
- Administrative Contracting Officer (ACO) - two (2) copies
- NAV(name)SYSCOM, Code (number) - one (1) copy

c. Deviation and Waiver requests (submit on DD Form 1694)

(1) Critical and Major Deviations and Waivers - Same distribution as Paragraph 2a above.

(2) Minor Deviations and Waivers - Original and two (2) copies to NAVOCEANSYSCEN, Code (number) unless NAVOCEANSYSCEN has redelegated approval authority of Minor Deviations/Waivers to DCAS wherein two copies of all DCAS approved actions would be forwarded to NAVOCEANSYSCEN, Code (number).

d. Notices of Revision (NORs) (submit on DD Form 1695), and Specification Change Notices (SCNs) (submit on DD Form 1969) - NORs and SCNs required for final Class I and II ECPs shall be submitted as follows:

- NAVOCEANSYSCEN, Code (number) - original and two (2) copies
- ACO - two (2) copies

3. Approval and issuance to the contractor of Class I and Class II ECPs including the associated Notices of Revision and Critical, Major and Minor Deviations and Waivers shall be accomplished as follows:

a. Class I ECPs and Major Waivers and Deviations which affect contract cost or schedule, and all Critical Waivers and Deviations:

Upon NAVOCEANSYSCEN's review for technical acceptability and recommendation for approval, to be approved by the Naval (name) Systems Command Contracting Officer and issued by the ACO. Implementation of an ECP prior to approval of the change by the Contracting Office is at the contractor's risk. A copy of all such Naval (name) Systems Command approved actions shall be submitted to NAVOCEANSYSCEN, Code (number) for information.

Class I ECPs and Major Waivers and Deviations which do not affect cost or schedule:

To be approved by the NAVOCEANSYSCEN and issued by the ACO.

b. Class II ECPs:

To be approved by the NAVOCEANSYSCEN and issued by the ACO.

c. Minor Deviations and Waivers

To be approved by the NAVOCEANSYSCEN and issued by the ACO. NAVOCEANSYSCEN may redelegate approval/disapproval of these to the DCAS, QAR. In such case, copies of all DCAS approved actions shall be forwarded to NAVOCEANSYSCEN on a weekly basis.

4. The contractor is expected to discuss his plans for the initiation of Engineering Change Proposals involving substantial engineering effort with NAVOCEANSYSCEN, Code (number), prior to initiating such effort. Such advance discussion is recommended for all Class I ECPs.

5. An advance copy of each ECP, Waiver and Deviation approved by the NAVOCEANSYSCEN for issuance by the ACO shall be provided to the contractor and to NAV(name)SYSCOM Code (number).

6. The contractor, in requesting any Deviation or Waiver, shall state whether and in what respects, if any, the performance, interchangeability or logistic support (e.g., technical manuals, spare parts) of any of the following will be affected:

a. The component incorporating the Deviation/Waiver

b. The contract end item in which the component will be incorporated

c. The system in which the contract end item will be incorporated

7. Separate Deviation or Waiver proposals (DD Form 1694) shall be submitted for each part number.

8. If a Deviation is recurring (i.e., a repetition or extension of a previous Deviation), the contractor shall examine the manufacturing practices and processes involved and determine whether an ECP shall be proposed. If a Waiver is recurring, the contractor shall examine his quality control operations to determine if they are adequate. The contractor shall provide this information at the time of submission of the Deviation or Waiver.

9. The contractor, when submitting requests for ECPs, Deviations or Waivers, shall include the serial numbers of the affected hardware. If the item affected by the change is itself not serialized, the serial number of the next highest serialized assembly shall be included. At the conclusion of production the contractor shall provide an "as built" listing, per CDRL item number (specify) which provides the initial contract baseline listing and shows all departures from that baseline resulting from the issuance or approval of Class I and II ECPs and Critical and Major Deviations and Waivers.

10. The contractor shall maintain configuration management listings showing the initiation, submission and government approval status of all ECPs, Deviations and Waivers originated by either the contractor or the government. Additionally, the contractor shall maintain a configuration status accounting report (CSAR) prepared in accordance with CDRL item number (specify). The CSAR shall reflect the product baseline and approved changes thereto including all Class I and II ECPs and all Critical and Major Deviations and Waivers.

11. Nothing contained in this section shall be construed as obligating the government in any manner whatsoever to approve or issue any changes, Deviations or Waivers which may be proposed by the contractor.

APPENDIX F

TECHNICAL MANUAL CONTRACT REQUIREMENT (TMCR)

NOTE: While this Technical Manual Contract Requirement (TMCR) originally was prepared for a NAVSEASYSCOM program, its principles apply to a large extent to other Navy programs. Unless the NOSC Project Office is familiar with the preparation of TMCRs, it is suggested that the Technical Information Department, Code 44, be contacted for assistance.

APPENDIX F

TECHNICAL MANUAL CONTRACT REQUIREMENT (TMCR) FOR (NAME) SYSTEM

SCOPE

This TMCR is for use in preparation of an operation and maintenance technical manual for the (name) System. This effort is being conducted under the authority of the Naval Sea Systems Command with the Naval Ocean Systems Center designated as the Technical Direction Agent. The TMCR covers requirements/clarifications/modifications/exceptions relative to the specifications cited in Paragraph 2, below. The requirements of the Data Item Descriptions (DIDs) listed on the DD Form 1423, in conjunction with the requirements herein, define the technical manual tasks to be performed by the contractor and the technical manual data items to be delivered.

1. CONTRACTOR FURNISHED MATERIAL

1.1 TECHNICAL MANUAL OUTLINE/BOOKPLAN. The contractor shall submit, for government approval, a technical manual outline/bookplan for one (1) type III system manual as directed by DD Form 1423 item number (specify) and this TMCR for the system technical manual identified in Paragraph 1.2.

Quantities to be delivered shall be as specified on DD Form 1423.

1.2 TECHNICAL MANUAL MANUSCRIPT COPY. The contractor shall submit, for government approval, manuscript copies for technical evaluation, approval, and interim use, as directed by DD Form 1423 item number (specify) and this TMCR, for the following manual:

Operation and Maintenance Instruction
(organizational level) for (name)
System

Quantities to be delivered shall be as specified on DD Form 1423.

2. SPECIFICATIONS/STANDARDS/GUIDES

The following documents of the exact issue shown form a part of this TMCR to the extent cited herein.

2.1	MIL-M-15071H (NAVY) (17 July 1978)	Manuals, Technical: Equipments and Systems, Content Requirements for
2.2	MIL-M-38784A (1 January 1975) with Amendment 5	Manuals, Technical: General Style and Format Requirements
2.3	MIL-M-81302A (AS) December 1967)	Manuals, Technical: In-Process (12 Reviews, Validation, and Verification, Support of

3. REQUIREMENTS

In the event of conflict among the requirements of this TMCR, the specifications cited herein, and the Data Item Descriptions (DIDs) cited in the CDRL (DD Form 1423), the requirements of this TMCR shall take precedence.

3.1 TECHNICAL MANUAL OUTLINE/BOOKPLAN. The manual outline to be furnished under Paragraph 1.1 shall be prepared in accordance with Paragraph 3.1.4 of MIL-M-38784A and Paragraph 3.13.1 of MIL-M-15071H and the following:

3.1.1 The manual outline shall indicate the planned technical content specified in Paragraph 3.2.8 of this TMCR.

3.1.2 The manual outline shall list each chapter and all primary and subordinate sideheads for each chapter.

3.1.3 The manual outline shall be reviewed by, and shall meet the approval of, NOSC. If disapproved, the unacceptable portions shall be corrected and resubmitted until approved. The approved manual outline shall then become part of the specifications governing preparation of the technical manual.

3.2 TECHNICAL MANUAL MANUSCRIPT COPY. The manuscript copy to be furnished under Paragraph 1.2 shall be prepared in accordance with Paragraphs 3.1.6.1 and 3.2.1 of MIL-M-38784A with the following exceptions/clarifications:

3.2.1 Illustrations, drawings and tables shall be final size, complete with title and figure or table number.

3.2.2 Copies shall be loose-leaf bound in vinyl-clad or equivalent binders.

3.2.3 FRONT MATTER. Front matter shall be prepared in accordance with MIL-M-38784A and shall include the following:

1. Cover (including back cover and backbone)
2. Title page
3. List of effective pages (A page)
4. Change record
5. Content assurance pages
   (a) Validation performance
   (b) Verification performance
6. Foreword
7. Table of contents (page i)
8. List of illustrations
9. List of tables

3.2.3.1 The front cover and title page shall include the words "MANUSCRIPT COPY" and bear the NAVSEA seal centered 1/2 inch below system nomenclature (subtitle).

3.2.3.2 FOREWORD. The foreword shall be printed on the next right-hand page following the verification performance page. The foreword shall describe briefly the scope and contents of the manual and shall clearly define the configuration of the manual. It shall indicate the structure of the technical manual by containing a list of the numerical designations and title for all

chapters and sections. The foreword shall be prepared in a single column format and shall be paginated "Foreword-1."

3.2.3.2.1 The foreword shall contain the following statement: "Ships, training activities, supply points, depots, Naval Shipyards, and Supervisors of Shipbuilding are requested to arrange for the maximum practical use and evaluation of NAVSEA technical manuals. All errors, omissions, discrepancies, and suggestions for improvement of NAVSEA technical manuals shall be reported to the Naval Sea Data Support Activity (NSDSA), Naval Ship Weapon Systems Engineering Station (NSWSES) (Code 5700), Port Hueneme, CA 93043 on NAVSEA Technical Manual Deficiency/Evaluation Report (TMDER, for NAVSEA 5600/2). To facilitate such reporting, three copies of form NAVSEA 5600/2 are included at the end of the bound part of this technical manual. All feedback comments shall be thoroughly investigated and originators shall be advised of any resulting action. Extra copies of form NAVSEA 5600/2 may be requisitioned from the Naval Publications and Forms Center (NPFC), Philadelphia, PA 19120."

3.2.4 NARRATIVE TEXT. Identity numbers, nomenclature, and referenced designations appearing throughout the text shall be the same as those appearing on government-approved documents. Minimum printed size for text shall be 10-point type.

3.2.5 PARAGRAPH FORMAT. Primary paragraphs shall be numbered in accordance with Paragraph 3.2.3.2.2 of MIL-M-38784A. All paragraphs, including those without headings, shall start at the left margin except as otherwise indicated below. Format shall be as follows:

3.2.5.1 NARRATIVE FORMAT WITH SIDEHEADS.

9-99. PRIMARY SIDEHEAD

First word of text and carryover lines flush left.

a. SECONDARY SIDEHEAD. (First subordinate paragraph) Text is run in with carryover lines flush left.

1. TERTIARY SIDEHEAD. (Second subordinate paragraph) Text is run in with carryover lines flush left.

(a) QUATERNARY SIDEHEAD. (Third subordinate paragraph) Text is run in with carryover lines flush left. This level of subordination is undesirable.

3.2.5.2 NARRATIVE FORMAT WITHOUT SIDEHEADS. Primary sidehead is mandatory.

9-99. PRIMARY SIDEHEAD

First word of text and all carryover lines flush left.

a. (First subordinate paragraph) Text follows subparagraph identifier with carryover lines flush left.

1. (Second subordinate paragraph) Text follows subparagraph identifier with carryover lines flush left.

(a) (Third subordinate paragraph) Text follows subparagraph identifier with carryover lines flush left. This level of subordination is undesirable.

3.2.5.3 LISTING FORMAT. Listing shall not appear under tertiary or quaternary sideheads or subparagraphs.

9-99. PRIMARY SIDEHEAD

First word of text and all carryover lines flush left.

1. First item
2. Second item
3. Third item, etc.

9-99. PRIMARY SIDEHEAD

First word of text and all carryover lines flush left.

a. SECONDARY SIDEHEAD. (First subordinate paragraph) Sidehead is not mandatory. Text is run in with carryover lines flush left.

1. First item
2. Second item
3. Third item, etc.

3.2.5.4 PROCEDURE FORMAT. Procedures shall not appear under tertiary or quaternary sideheads or subparagraphs. (Procedures which require observations or alternatives should be in tabular format rather than text.)

9-99. PRIMARY SIDEHEAD

First word of text and all carryover lines flush left.

1. First principal step. Carryover lines shall be blocked flush with initial letter of first word.

2. Second principal step. Carryover lines shall be blocked flush with initial letter of first word.

3. Third, etc.

9-99. PRIMARY SIDEHEAD

First word of text and all carryover lines flush left.

a. SECONDARY SIDEHEAD. (First subordinate paragraph) Sidehead is not mandatory. Text is run in with carryover lines flush left.

1. First principal step. Carryover lines shall be blocked flush with initial letter of first word.

2. Second principal step. Carryover lines shall be blocked flush with initial letter of first word.

3.2.6 ILLUSTRATIONS. Each full-page or partial-page illustration shall follow as closely as possible to the first reference to it in the chapter in which it is contained. All figures shall have a title and shall be numbered in accordance with the requirements of MIL-M-38784A, Paragraph 3.2.3.2.2. Line art, including schematics, wiring diagrams, and block diagrams shall be of a quality suitable for reproduction. Identity numbers, nomenclature, callouts, tabular materials, and symbols on illustrations shall be upper case with 8-point minimum reproduced size. There shall be no drawing data, other than horizontal lines, placed closer than 1/8-inch from the image area limit. Illustrations shall be final reproduction size and within the following image area limitations:

a. Vertical page -- 7" x 9"

b. Horizontal page -- 9" x 6-1/2"

c. Foldouts -- 9" x 36" (excluding blank apron)

3.2.6.1 Foldout illustrations shall be placed in Chapter 8. Numbering and pagination shall be in accordance with requirements of MIL-M-38784A, Paragraph 3.2.3.2.2.

3.2.6.2 Full-page blank apron shall be provided on the bind edge of all foldouts.

3.2.6.3 Foldup sheets and foldup-foldout sheets shall not be used.

3.2.6.4 Halftone artwork shall not be used without prior approval of NOSC.

3.2.6.5 Reproducible artwork shall be provided and shall be mounted, identified, and covered in accordance with requirements of MIL-M-38784A, Paragraphs 3.6.32, 3.6.24, and 3.6.25.

3.2.6.6 Color shall not be used unless the copy cannot be reproduced in black and white without loss of intelligibility. Color shall not be used without prior approval of NOSC.

3.2.7 ALPHABETICAL INDEX. An alphabetical index shall be provided in accordance with MIL-M-38784A, Paragraph 3.2.11.9.

3.2.8 TECHNICAL CONTENT. The technical content of the manual shall provide coverage within the limits of the shipboard capabilities and to the extent cited herein. When adequate information is provided in other official related technical publications, such information shall be properly referenced and shall not be duplicated if data exceed one full page. Information of one full page or less shall be duplicated.

3.2.8.1 The technical content shall meet the requirements for the type III manual of MIL-M-15071H, Paragraphs 3.6 through 3.6.10.11.2 and be in accordance with the following arrangement:

1. Chapter 1 - General Information
2. Chapter 2 - Safety Precautions
3. Chapter 3 - Conditions of Readiness
4. Chapter 4 - Operation
5. Chapter 5 - Functional Description
6. Chapter 6 - Scheduled Maintenance
7. Chapter 7 - Fault Isolation
8. Chapter 8 - Foldouts (if required)

3.2.8.2 CLASSIFIED MATERIAL. Classified material, if required, will be provided in a classified supplement to the applicable manual. Each supplement will follow the same format as the basic manual, and shall be prepared in accordance with OPNAVINST 5510.1F (26 September 1978) and Change 1 (9 November 1978).

3.2.9 REVIEW AND APPROVAL. The technical manual manuscript copy shall be reviewed by, and shall meet the approval of, NOSC. If disapproved, the unacceptable portion shall be corrected and the complete manual resubmitted until approved.

4. GOVERNMENT FURNISHED MATERIAL

None

5. SCHEDULE OF DELIVERY

5.1 TECHNICAL MANUAL OUTLINE/BOOKPLAN. The technical manual outline/bookplan furnished under Paragraph 1.1 shall be packaged in accordance with good commercial practices and shall be delivered to addressees in accordance with the schedule listed on DD form 1423. Marking of packages shall conform with the requirements of MIL-M-38784A, Paragraphs 5.2 and 5.3.

5.1.1 Review comments will be forwarded to the contractor within thirty (30) days after receipt of the manual outline/bookplan.

5.2 TECHNICAL MANUAL MANUSCRIPT COPY. The technical manual manuscript copy furnished under Paragraph 1.2 shall be packaged in accordance with good commercial practices and shall be delivered to addressees in accordance with the schedule listed on DD form 1423. Marking of packages shall conform with the requirements of MIL-M-38784A, Paragraphs 5.2 and 5.3.

5.2.1 Review comments will be forwarded to the contractor within thirty (30) days after receipt of the manuscript copy.

6. QUALITY ASSURANCE PROVISIONS

The requirements for quality assurance shall be in accordance with the following:

6.1 IN-PROCESS REVIEW. The in-process reviews will be coordinated by NOSC and conducted at the contractor's facility. Material shall be made available during the developmental phase in order to conduct a review of manner of presentation, depth of coverage, and to ensure compliance with requirements of the TMCR. The contractor shall establish an in-process review schedule at the

25, 50 and 75 percent completion points of the manuscript copy and shall notify NOSC when the material is available for review. The validation and verification plan shall be documented in accordance with CDRL item number (specify) and shall be submitted for government approval.

6.2 VALIDATION. Validation shall be performed by the contractor in accordance with Paragraphs 3.3 through 3.3.9 of MIL-M-81203A to ensure accurate and adequate format and technical content coverage. A certificate of validation shall be prepared attesting to the accuracy and adequacy of each deliverable item cited herein.

6.2.1 CONTENT ASSURANCE -- VALIDATION PERFORMANCE. The validation performance page shall be filled in and signed for the technical manual manuscript furnished under Paragraph 1.2.

6.3 VERIFICATION. Verification is the process by which the government confirms that the contractor's validation of the technical manuals for compliance with the requirements of the TMCR is reliable and represents true compatibility with the associated hardware. Verification should be performed in a shipboard environment.

7. TECHNICAL MANUAL COST AND PRINTING ANALYSIS

The contractor shall submit all cost estimates or pricing information pertaining to technical manuals on the revised DD Form 633-2 in accordance with the instructions covering its use contained in the Defense Acquisition Regulation (DAR). A completed form, containing all required information, shall be submitted for each volume of the manual affected. The original of these forms and all supporting data shall be sent to the contracting officer. One copy of these forms and all supporting information shall be sent directly to NOSC. One copy of these forms and all supporting information shall be sent directly to Naval Ship Weapon Systems Engineering Station, NSDSA (Code 5700), Port Hueneme, CA 93043.

8. PRODUCTION OF COMPOSITION AND/OR NEGATIVES

The production of composition and/or lithographic negatives procured under this contract is granted by JCP Authorization 23383.

NOTE: Citation of the authorization in contracts is required by Public Law Title 44 U.S. Code NAVMAT P-4202 Navy Procurement Directives. The authorization legalizes procurement and pertains only to Federal department or agency receiving it and in no way affects the preparation and production of reproducible copy or negatives by the contractor.

APPENDIX G

QUALITY ASSURANCE PROGRAM REQUIREMENTS

NOTE: This Quality Program Requirements Document, which includes separate requirements for full-scale development (pages G-1 through G-3) and for production programs (pages G-4 through G-7), emphasizes those quality assurance concerns relating to hardware. Where special emphasis on particular quality assurance elements is desired, this document may be supplemented with individual requirements from Sections 3.1, 3.2, 3.3, 3.4 or 3.5 of this manual as needed. Also see Paragraphs 3.1.17 and 3.4.2 for guidance. For more information regarding computer software quality assurance, it is suggested that the NOSC Project Office contact the Software Quality Control Branch, Code 9133. For more information regarding hardware quality assurance, it is suggested that the Product Assurance Division, Code 931, be contacted.

APPENDIX G

QUALITY ASSURANCE PROGRAM REQUIREMENTS FOR DEVELOPMENT PROGRAMS

1. The contractor's Quality Assurance Program shall meet the requirements of specification MIL-Q-9858 and, where computer software is involved, shall comply with MIL-S-52779. The issue of these and other referenced documents in effect on the date of invitation for bids shall apply.

2. The contractor's Quality Assurance Program Plan shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy Program Office approval. An information copy of the Plan shall be provided to the local government representative. Failure to obtain Navy Project Office approval of the Quality Assurance Program Plan shall not relieve the contractor from meeting contract delivery schedules.

3. The following Quality Assurance Program requirements are supplemental to or otherwise modify those requirements specified in the following paragraphs of MIL-Q-9858:

a. Paragraph 3.2 - Initial Quality Planning

(1) The contractor's Quality Assurance Program Plan shall contain a description of the quality assurance organization, including the responsibility and authority of each functional element, and other documentation prepared to implement the quality assurance program. The plan shall identify all policies, existing instructions and procedures which are necessary to comply with the provisions of this specification.

(2) The contractor shall determine indoctrination and training requirements for this contract and shall establish training programs for personnel involved in fabrication, assembly, inspection and test operations and for other personnel whose work has an affect on the quality of the product. Those personnel responsible for fabrication, assembly and inspection, or for control of special processes and operations which require special skills and could affect product quality shall be certified. Records of all certified personnel shall be maintained current and up-to-date.

b. Paragraph 3.3 - Work Instructions

(1) Detailed work instructions for fabrication, assembly and inspection procedures need not be prepared. However, general work instructions, including adequate reference to applicable drawings and specifications and to workmanship requirements, are required for these operations.

(2) Specific written test procedures shall be prepared for each component, subassembly or assembly acceptance test to be performed by the contractor.

c. Paragraph 3.6 - Costs Related to Quality

Quality cost data need not be accumulated.

d. Paragraph 5.1 - Responsibility

(1) The contractor is responsible to the government for the quality of the contractor's and supplier's products. The contractor should ensure that the requirements of this quality specification shall be passed down to all major subcontractors except where otherwise approved, in writing, by the government. Delegation of inspection operations to subcontractors and suppliers shall be documented in clear and complete instructions and shall include all requirements necessary for control of quality.

(2) The contractor shall have objective evidence that all subcontractors and suppliers comply in detail with applicable requirements and assure that all specified inspections and tests required for acceptance have been satisfactorily performed. Evidence of such inspections and tests shall be made available to the government upon request.

e. Paragraph 5.2 - Purchasing Data

(1) The contractor's written procedures shall indicate that each procurement document is reviewed by the contractor's quality assurance organization prior to release and shall be available for review by the government representative. This review shall assure that quality assurance requirements are included in the procurement document.

f. Paragraph 6.1 - Materials Control

(1) The contractor's receiving inspection shall assure that supplies are not accepted unless they have been inspected in accordance with the requirements of the subcontract/purchase order and satisfactory evidence of such inspection is submitted. The quality assurance program shall provide for planning and performance of inspections and tests on all supplies to assure verification of quality assurance requirements of specifications and drawings either at the source or at the contractor's plant, or both.

(2) The quantity and degree of inspection performed shall be consistent with the complexity and critical nature of the article, the information available from previous inspections or tests and the drawing and specification requirements for the article.

(3) Procured supplies which are subject to age deterioration shall include an indication of the date after which the material shall not be used.

g. Paragraph 6.2 - Production Processing

The contractor's program shall provide the necessary planning function for tests and inspections conducted during the entire phase of fabrication, processing and assembly. Inspections shall be established at points which will minimize delays resulting from deficiencies, and in all cases shall be at or before the last point at which acceptability of the operation or quality of the characteristic may be verified.

h. Paragraph 6.6 - Statistical Quality Control and Analysis

All completed functional units (e.g., hydraulic actuators, pressure vessels, gear assemblies, cables, microcircuits, printed circuit assemblies, high level assemblies) and final assemblies shall be inspected 100 percent. All components (e.g., resistors, diodes, transistors, printed circuit boards) of such functional units and of final assemblies shall be inspected 100 percent unless the lot size of identical components exceeds 20, in which case sample inspection may be employed. Unless otherwise specified, such sample inspection shall be in accordance with MIL-STD-105D, Inspection Level II with all functional characteristics and features of such components inspected to the AQL specified in the following:

LOT SIZE	AQL
1-20 units	100 percent inspection
21-50 units	.65
151 and above	1.5

Non-functional characteristics and features of such components shall be inspected as follows:

LOT SIZE	AQL
1-20 units	100 percent inspection
21-50 units	1.5
51-150 units	4.0
151 and above	6.5

i. Paragraph 4.1 - Drawing, Documentation and Changes

(1) The contractor's quality program shall include provisions for determination of compliance to contract requirements of all technical data, including engineering drawings and specifications, listed on the CDRL (DD-1423) prior to delivery of such data to the government.

QUALITY ASSURANCE PROGRAM REQUIREMENTS
FOR PRODUCTION PROGRAMS

1. The contractor's Quality Assurance Program shall meet the requirements of specification MIL-Q-9858 and, where computer software is involved, shall comply with MIL-S-52779. The issue of these and other referenced documents in effect on the date of invitation for bids shall apply.

2. The contractor's Quality Assurance Program Plan shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval. An information copy of the Plan shall be provided to the local government representative. Failure to obtain government approval of the Quality Assurance Program Plan shall not relieve the contractor from meeting contract delivery schedules.

3. The following Quality Assurance Program requirements are supplemental to those requirements specified in the following paragraphs of MIL-Q-9858:

a. Paragraph 3.2 - Initial Quality Planning

(1) The contractor's Quality Assurance Program Plan shall contain a description of the quality assurance organization, including the responsibility and authority of each functional element, and other documentation prepared to implement the quality assurance program. The plan shall identify all policies, existing instructions and procedures which are necessary to comply with the provisions of this specification.

(2) Flow charts, work instructions, and in-process inspection and test instructions shall be prepared to a level commensurate with the effort. Detail shall be sufficient to identify proper procedures to the operator. The level of detail for work to be conducted in connection with full-scale development need not reflect the exactness of instructions required in a production phase environment.

(3) The contractor shall determine indoctrination and training requirements for this contract and shall establish training programs for personnel involved in manufacturing and quality control and for other personnel whose work has an effect on the quality of the product. Those personnel responsible for manufacture, inspection, or for control of special processes and operations which require special skills and could affect product quality shall be certified. Records of all certified personnel shall be maintained current and up-to-date.

b. Paragraph 3.3 - Work Instructions

(1) All fabrication, assembly, inspection and test instructions shall be placed under the contractor's document control system to maintain control of changes, and shall be available for review by government representatives.

(2) Specific written test procedures shall be prepared for each acceptance test operation to be performed by the contractor. These test procedures shall be maintained current in accordance with the change control system requirements and shall include the following:

(a) Identification of the item to be tested such as part number with revision letter and nomenclature

(b) The characteristic to be verified

(c) Measuring and testing equipment to be used to verify each characteristic, i.e., plug gage, tapes, scopes, ohmmeter, etc.

(d) Detailed operations to be performed by the test operator, including operational checks or preliminary calibration of test setup

(e) Exact method of measuring including necessary manipulation of controls on the article involved and on the measuring and test equipment

(f) Conditions that must be maintained during test, including ambient or environmental conditions, and precautions to be observed to prevent damage to the articles or instruments involved

(g) Criteria for passing or failing the test or for determining conformance or rejection of the article including reference to the workmanship standards

(h) Details of sampling plans to be used if applicable

(i) All characteristics included in the specifications and drawings; each characteristic that has been classified in these documents as critical or major shall be identified in the test procedures by a suitable symbol or number

(3) The contractor shall maintain records of all tests and inspections performed throughout the entire procurement, fabrication and assembly cycle. The records shall provide objective evidence that required inspections and tests have been performed and shall include part, component or system identification, inspection or test involved, number of conforming articles, number rejected and causes for rejection. The records shall cover both conforming and non-conforming items. Where variables data are involved, the actual numerical results obtained shall be indicated, and where data or information are recorded, the film, tape or other recording media shall be identified with the characteristic measured. For non-conforming articles, the records shall include the results of analysis, cause and corrective action taken. Corrective action records will also include a follow up action report to substantiate the effectiveness of each corrective action.

c. Paragraph 5.1 - Responsibility

(1) The contractor is responsible to the government for the quality of supplier's products. Delegation of inspection operations to suppliers shall be documented in clear and complete instructions and shall include all requirements necessary for control of quality.

(2) The contractor shall have objective evidence that the supplier complies in detail with applicable requirements and assure that all specified

inspections and tests required for acceptance have been satisfactorily performed. Evidence of such inspections and tests shall be made available to the government upon request.

d. Paragraph 5.2 - Purchasing Data

(1) The contractor's written procedure shall indicate that each procurement document is reviewed by the contractor's quality assurance organization prior to release and shall be available for review by the government representative. This review shall assure that all quality assurance requirements are included in the procurement document

e. Paragraph 6.1 - Materials Control

(1) The contractor's receiving inspection shall assure that supplies are not accepted unless they have been inspected in accordance with the requirements of the subcontract/purchase order and satisfactory evidence of such inspection is submitted. The quality assurance program shall provide for planning and performance of inspections and tests on all supplies to assure verification of quality assurance requirements of specifications and drawings either at the source or at the contractor's plant, or both.

(2) The quantity and degree of inspection performed shall be consistent with the complexity and critical nature of the article, the information available from previous inspections or tests and the documentation requirements on the article.

(3) Procured supplies which are subject to age deterioration shall include an indication of the date after which the material shall not be used in manufacturing process.

f. Paragraph 6.2 - Production Processing

(1) The contractor's program shall provide the necessary planning function for tests and inspections conducted during the entire phase of fabrication, processing and assembly. Inspections shall be established at points which will minimize delays resulting from deficiencies, and in all cases shall be at or before the last point at which acceptability of the operation or quality of the characteristic may be verified.

(2) Process control procedures shall be prepared when necessary to supplement applicable process specifications to provide detailed performance and control methods. These procedures shall document the preparation, fabrication details, conditions to be maintained during each phase of the process, the methods of verifying the adequacy of processing materials, solutions, equipment, their associated control parameters, including statistical quality control plans where applicable, and the required records to indicate the results of such inspection and process verification. The contractor's quality assurance organization shall review the written procedures for the process controls. Such procedures shall be made available to the government representative.

(3) Unless otherwise specified by the drawings and specifications, the contractor's workmanship standards shall, as a minimum, conform to the requirements of MIL-STD-454, Requirements 5 (Soldering) and 9 (Workmanship).

g. Paragraph 6.6 - Statistical Quality Control and Analysis

(1) An inspection lot shall consist of items manufactured under essentially the same conditions and at essentially the same time. Prior to submittal of each inspection lot to the government representative, the contractor shall provide inspection and/or test records that assure the units presented have passed all inspections and tests required by the applicable drawings, specifications and quality assurance documentation.

(2) Component Inspection and Test Requirements

The contractor shall inspect and test all components for the purpose of determining the acceptability of such components for incorporation into higher level assemblies, in accordance with the following:

(a) Items covered by Military Specifications shall be inspected in accordance with the applicable specification.

(b) Items covered by specification control, altered item, selected item or source control drawings and which are not covered by military specifications shall be inspected to the drawings in accordance with MIL-STD-105, Inspection Level II, to an AQL of .65, unless the lot size is 20 or less, in which case the items shall be inspected 100 percent. Item verification and AQL application may be on an individual characteristic basis.

(c) Items covered by detailed design disclosure drawings shall be inspected in accordance with those drawings, as follows:

1. Where the item drawing establishes specified functional requirements, the items shall be inspected/tested to those functional requirements on a 100 percent basis, except where verification on a sample basis is allowed by the drawing or by an associated specification or where the contractor proposes and the government agrees, in writing, to permit sample testing of specific functional requirements of specifically identified components.

2. Where the item's characteristics have been classified on the drawing, these classified characteristics shall be inspected as follows:

a. Critical characteristics (C1), C2, etc.) shall be verified 100 percent.

b. Major characteristics (M101, M102, etc.) shall be verified on a "Class" basis (AQL applies to the entire group of characteristics taken as a whole — see DOD-STD-2101, Paragraph 50.7.1) in accordance with MIL-STD-105, Inspection Level II, to the AQL indicated in the following table:

LOT SIZE	AQL (APPLIED BY CLASS)
1 - 20 units	100 percent inspection

LOT SIZE	AQL (APPLIED BY CLASS)
21 - 150 units	.65
151 and above	1.5

c. Minor characteristics (201, 202, etc.) may be verified on an "individual" basis (AQL applies to each characteristic individually) in accordance with MIL-STD-105, Inspection Level II to the AQL indicated in the following table:

LOT SIZE	AQL
1 - 8 units	100 percent inspection
9 - 50 units	1.5
51 - 150 units	4.0
151 and above	6.5

d. Unclassified characteristics shall be verified in accordance with a plan established by the supplier, subject to the concurrence of the government representative.

e. Except where otherwise specified by the drawing or an associated specification, certified test or inspection data will be acceptable as verification of material or process requirements.

f. The contractor may apply a more stringent (e.g., use lower AQLs) sampling plan if he so chooses.

g. Where the item's characteristics have not been classified or such classification appears to be incomplete, the contractor shall develop his own characteristics applying the sampling plan guidelines of (2)(a), (b) and (c) above or tighter.

h. Paragraph 4.1 - Drawing, Documentation and Changes

(1) The contractor's quality program shall include provisions for determination of compliance to contract requirements of all technical data listed on the CDRL (DD-1423) prior to delivery of such data to the government.

APPENDIX H

PROCUREMENT DATA PACKAGE REQUIREMENTS

NOTE: This Procurement Data Package Requirements Document, which anticipates procurement of production units by the equipment developer on a one time basis only (limited production), relates to both hardware and computer software, but it may be incomplete concerning computer software. For more information regarding computer software, it is suggested that the NOSC Project Office contact the Software Quality Control Branch, Code 9133. For more information regarding hardware procurement data, it is suggested that the Product Assurance Division, Code 931, be contacted.

Should it be anticipated that the procurement of production units will be on a competitive basis or that additional production is likely, this document may be utilized providing that the drawing level requirement (Paragraph 1.2.3.1) is changed from Level 2 to Level 3.

APPENDIX H

PROCUREMENT DATA PACKAGE REQUIREMENTS

FOREWORD

1. This document provides the Procurement Data Package requirements (hardware and computer software) for the Full Scale Development of the (name) System.

2. The following requirements shall be used to develop a Procurement Data Package that will be used by the Navy to establish a Product Baseline by which to begin the production and logistic support of the (name) System.

3. The (name) System is being developed under the authority of the Naval (name) Systems Command with the Naval Oceans Systems Center designated as the Technical Direction Agent.

4. The document issue in effect on the date of invitation for bids shall apply to all referenced documents.

CONTENTS

1. ENGINEERING SUPPORT REQUIREMENTS

1.1 General Requirements. During the Full Scale Development Phase informal records will be required for the following:

a. Design calculations
b. Design trade-offs
c. Drawing checking calculations
d. Programmer's notebooks

The above records shall be maintained and kept current for periodic inspection.

1.2 Design Disclosure Package Requirements. This section contains the requirements for documentation of the hardware and software.

1.2.1 System Software
1.2.2 Specifications
1.2.3 Engineering Drawings and Associated Lists
1.2.4 Configuration Management
1.2.5 Program Parts Selection List

1.2.1 Computer Software. The (name) system computer software (programs, firmware and data bases) shall meet the requirements of the (name) system specification, NAVOCEANSYSCEN (number) and MIL-STD-1679.

1.2.1.1 Computer Software Development Plan. The contractor shall ensure that computer software developed under this contract shall be developed in accordance with a well ordered and structured software development plan, per CDRL item number (specify). This plan shall be formalized and presented to the government and shall reflect the actual policies, practices and procedures followed by the contractor for developing computer software.

The contractor's Software Development Plan shall include the identification and description of administrative instruments used by the contractor to monitor the computer software development process. This Plan shall also be enhanced by work breakdown structures (WBS) which describe functional relationships between units of the computer software developmental organization, key administrative functions and positions, document and communication flow and work cost breakdowns. The contractor will not be required to substantially modify his normal policies, practices or procedures relating to the development of computer software where he can demonstrate to the government that they are not substantially in conflict with the specifications and standards invoked in this contract.

The software development plan shall specify that development of the System Operator Manuals and Operator Manuals (OM) are initiated at the same time that the PPS development is initiated and that these documents are developed simultaneously with the development of the system.

1.2.1.2 Program Performance Specification. The Program Performance Specification, CDRL item number (specify), describes the performance requirements for the computer program portion of a given digital processor system. The Program Performance Specification contains performance criteria in terms of

operational, functional and mathematical language. It will be used by digital processor design personnel and by personnel responsible for management, procurement and maintenance of the digital processor program. Upon acceptance by NAVSEASYSCOM, the Program Performance Specification becomes the baseline document for configuration control of all subsequent programming efforts for the digital processor system. This document provides basis for the Computer Program Test Plan and the Operator's Manuals which can be drafted at this time.

1.2.1.3 Interface Design Specification. When two or more data systems are interfaced at the on-line interdigital processor level, a specification document for the interdigital processor message traffic in format and content must be developed for their interchange. This is the intent of the Interface Design Specification, CDRL item number (specify), which is a record of the agreed upon interchange message data formats, content, timing requirements, originating signal source, disposition of exchanged data. The Program Performance Specifications in the respective interfaced data systems are the objects to be coordinated by use of Interface Design Specifications, so that at the program level the intercommunications will function consistently and coherently in actual operation.

1.2.1.4 Program Design Specification. This document, CDRL item number (specify), shall contain the design details for the digital processor program in programming language. It is prepared for the use of personnel responsible for the composition, program testing and, ultimately, for the program maintenance of the digital processor programs and subprograms, as well as those responsible for the achievement of the program capability in function and system operation. Program Performance Specifications shall be the statements of requirements to be satisfied by the Program Design Specification. The Computer Program Test Plan, as well as Operator's Manuals, are based on this document.

1 2.1.5 Program Description Document. The Program Description Document, CDRL item number (specify), contains the design details for each subprogram of the digital processor program. It is generated from the Program Design Specification and represents the further detailing of the digital processor program into individual operations to be performed by the digital processor program. It is specifically oriented to programming logic and programmer's language and develops the basic subprogram logic for each subprogram section and subroutine. In effect, the Program Description Document presents the results of the programming efforts and provides the verification that the program fulfills the original requirements.

1.2.1.6 Operator's Manual. This document, CDRL item number (specify), is the digital processor equipment user's reference manual and provides for instructions for keeping the delivered program operating as designed to include any diagnostic and/or maintenance programs in support of the operational program. It is based upon the Program Design Specification and Computer Program Test Reports and is intended for the specific use of the digital processor users.

1.2.1.7 System Operator's Manual. The System Operator's Manual (and training manual, if separate), CDRL item number (specify), is intended to be the sole reference for individual operator training and combat station function, written in such detail that no other user document is necessary. It is also to

serve as a handbook for reference for trained operators. The Manual includes all aspects, modes and procedures necessary for each console or station operator. Operating instructions are not included for equipment whose function is satisfied purely by turn-on and turn-off procedures that are affected by program action or reaction. The System Operator's Manual is derived from the Program Performance Specification, but restructured to serve combat operators instead of programmers and system development authorities. Every control button, switch, readout and display affected by the system program is covered completely at the level required by system operators. Illustrations of the equipment are included to aid operators in locating controls. Equipment operations not determined by programs, such as turn-on procedures and equipment maintenance checks, are not covered, provided the information is available in the handbook furnished with the equipment. Equipment interconnections necessary for correct system operation are included.

1.2.1.8 Computer Program Test Plan. The Computer Program Test Plan, CDRL item number (specify), shall define the scope of tests required to ensure that the system, function and/or program meet all applicable technical, operational and performance specifications.

1.2.1.9 Computer Program Test Procedures. Testing of completed programs in a simulated environment with real or simulated peripheral equipment requires some test exercise scenarios or a typical operating user order of events. The test implementation is recorded with a description of the test exercise script of events and documented as Computer Program Test Procedures, CDRL item number (specify).

1.2.1.10 Computer Program Test Report. Testing of completed programs in a simulated environment with real or simulated peripheral equipment requires some test exercise scenarios or a typical operating user order of events. The test implementation is recorded with a description of the test exercise script of events which are documented as Computer Test Reports, CDRL item number (specify).

1.2.1.11 Program Package Document. The Program Package Document, CDRL item number (specify), shall consist of all the items necessary for NAVSEASYSCOM to produce and maintain the digital processor program. These items shall include, but not be limited to, the digital processor program source card deck or equivalent magnetic tape, object program tape, a source deck listing, an error-free source/object listing produced by an assembly or compilation of the source decks, a complete cross-reference listing produced by a compilation of the source decks and any data which are necessary for programs to run properly (e.g., adaptation data, data file contents, set up data, program parameter values).

1.2.2 Specifications. This section includes the requirements for preparing, maintaining and furnishing a specification tree, as well as preliminary product, process, material and computer software specifications.

1.2.2.1 Specification Requirements.

a. Specifications MIL-S-83490, Form lb: As a means of communicating the contractor's recommended design approach, the (name) System Specification Development NAVOCEANSYSCEN (number) shall be expanded and modified as may be

necessary with such changes documented and submitted for Navy consideration as described in the Configuration Management Requirements section of the contract. The specification changes specifically shall:

(1) State the specific design approach recommended for full-scale development

(2) Provide a description of operation of the (name) system, items and computer software together with system and subsystem performance requirements and the test procedures proposed to verify that these requirements are satisfied

b. Specification Tree. The specification tree, CDRL item number (specify), shall diagram the complete (name) system showing specification coverage for all prime items, critical items and computer software (programs, firmware and data bases) and lesser level subassemblies to sufficient depth to cover all Intermediate Maintenance Activity (IMA) level, Interchangeable Replacement Items (IRIs) and spares identified during the ILS planning. In addition, specification coverage for special materials and processes and support equipment (test equipment at the IMA and Organization level, handling equipment and containers) necessary to assemble/disassemble, test, maintain, transport, store, deploy and monitor the (name) system shall be identified and included. Each specification shall be identified by Navy nomenclature and contractor number.

c. Specifications, MIL-S-83490 Form 1b, Type B. Type B development specifications, CDRL item number (specify), shall be prepared for each configuration item (hardware and software) identified by the specification tree. The Type B development specifications shall evolve into the Type C product specifications required below.

d. Specifications, MIL-S-83490 Form 1b, Types C, D and E. Type C product specifications, CDRL item number (specify), shall be prepared for each configuration item (hardware and software) identified in the specification tree. Type D and E process and material specifications, CDRL item number (specify), shall be prepared for those processes and materials that are not documented by an acceptable military or industry specification or standard.

1.2.3 Engineering Drawings and Associated Lists. Drawings and associated lists shall conform to the requirements of DOD-D-1000.

NOTE: Level 3 drawings should be specified in the following paragraph if competitive, repetitive production is anticipated (see Paragraph 3.1.19.1.4). Other requirements remain the same.

1.2.3.1 Level 2 Design Disclosure. Except for spare parts which shall be documented to the Level 3 drawing requirements (Paragraph 1.2.3.2), the detail design of the (name) system and its associated equipment and the system installation and interface shall be documented in accordance with DOD-D-1000, Level 2 and DOD-STD-100. In addition to the Level 2 drawing procurement requirements of Attachment 1 (DOD-D-1000, Paragraph 6.2 ordering data - see

Appendix J) to CDRL item number (specify), the following requirements shall apply:

a. Installation control drawings shall be prepared to ensure efficient installation of the (name) system in its designated platform/facility.

b. Interface control drawings shall be prepared to ensure that the platform/equipment interfaces are compatible with the (name) system.

c. Printed circuit/wiring board design and documentation shall be in accordance with MIL-STD-275. Artwork/master patterns shall be capable of producing printed circuit/wiring boards that conform to MIL-P-55110.

d. Documentation depicting printed circuit/wiring boards shall include the following requirements:

(1) The printed circuit/wiring board shall be in accordance with MIL-P-55110.

(2) Soldering shall be in accordance with MIL-STD-454 Requirement 5.

(3) Workmanship shall be in accordance with MIL-STD-454 Requirement 9.

e. Engineering drawings that depict components or assemblies with functional characteristics (i.e., hydraulic actuators, pressure vessels, gear assemblies, cables, printed circuit assemblies, hybrid microcircuits, backplane assemblies, etc.) shall specify toleranced input and output parameters and inspection, test and evaluation criteria for acceptance of the hardware. The parameters and criteria shall be adequate to assure performance in the predicted worst-case environment for the equipment. As a minimum, complex digital circuitry shall be checked for continuity/isolation of each circuit and tested to verify proper operation of each active circuit element. Test requirements for complex digital hardware may be specified through automated-test program language (MIRCO, for example) when sufficient test software documentation is provided to allow independent determination of tolerances and circuits under test.

f. All levels of interconnect harnesses shall be defined on appropriate grids. Exceptionally long cables may have detail dimensioning in lieu of grids.

g. Dash numbers following the NAV (name) SYSCOM part number (3235961-001) shall be numeric only and shall be used only to tabulate variations in otherwise identical parts (resistor/capacitor values, etc.).

h. In electronic assembly documents, the component reference designator (U1, R2, C3, etc.) shall be used as the item number on the assembly drawing and the parts list.

i. Use of fractions or fractional tolerances shall be avoided in general. Fractions shall not be used in conjunction with geometric tolerances (ANSI-Y14.5).

j. Rule No. 2 of ANSI-Y14.5 shall be used in lieu of Rule No. 2a.

k. The contractor shall incorporate NAVOCEANSYSCEN comments from the initial drawing review and forward two copies to NAVOCEANSYSCEN pending final delivery of the original vellums.

l. Drawing tree charts, CDRL item number (specify), shall be generated and maintained throughout the engineering development effort. Updates shall be generated as required, but at least quarterly. One chart shall show the complete (name) system down to the subassembly level. Individual charts shall then depict the structure of the subassembly items down to the individual component level.

1.2.3.2 Level 3 Design Disclosure. The detail design of (name) system components, subassemblies and assemblies that are likely to be designated as spare parts shall be documented in accordance with DOD-D-1000, Level 3. The requirements of Paragraphs 1.2.3.1e through 1.2.3.1l shall apply in addition to the Level 3 procurement requirements of Attachment 1 (ordering data - see Appendix K) to CDRL item number (specify). Also, all such spare parts drawings shall have all physical and functional interface characteristics classified in accordance with DOD-STD-2101 and all such classified drawings shall include the note of attachment (specify - a recommended note is included as Appendix L). Where a component or assembly initially thought not to be such is later identified as a spare part, the drawings for the component or assembly shall be upgraded to the Level 3 requirements.

1.2.4 Parts and Materials Selection and Control. The contractor shall establish a parts and materials selection and control program which shall provide for the following:

a. Establishment of a parts control program meeting the requirements of MIL-STD-965, Procedure I. The selection of parts to be utilized in the design shall be in accordance with a Navy approved Program Parts Selection List (PPSL) based on suitable application and qualification to specified requirements using available reliability data. The order for selection of standards and specifications for parts and materials shall be in accordance with MIL-STD-143, with full consideration of the specified performance, qualification, reliability, safety and configuration management requirements. As a minimum, passive electronic components shall be selected from Established Reliability (ER) military specifications and shall have an ER failure rate of "P" or better (i.e., R, S or T). Additionally, discrete semiconductors shall be MIL-S-19500 level "JANTX" or better (i.e., JANTXV or JANS) and microcircuits shall be MIL-M-38510 Class "B" or better (i.e., S). Standard electronic modules, in accordance with MIL-STD-1378, shall be used in all new design applications.

The PPSL shall be documented in accordance with CDRL item number (specify) and shall be submitted for Navy approval. Parts not included in the PPSL may not be used without specific Navy approval of a nonstandard parts request prepared in accordance with CDRL item number (specify).

b. Maximum use of previously qualified parts and materials

c. Establishment of a parts derating policy meeting the requirements of NAVSEA 0967-LP-597-1011 and the performance of circuit element stress analysis to verify compliance with that derating policy

d. Minimization of the total types and numbers of parts and material

e. Minimum use of limited-life items

f. Selection of parts and materials which will be readily available as long-term supply items

g. Exclusion of toxic materials, except when specifically approved by the procuring activity

h. Consideration of transportation, handling, storage and installation limitations

i. Availability of multiple procurement sources

j. Product producibility

APPENDIX I

"ORDERING DATA" FOR LEVEL 1 ENGINEERING DRAWINGS

NOTE: "Ordering data" are those supplementary procurement requirements data (DOD-D-1000B, Paragraph 6.2.1) which must be furnished to the supplier when specifying the preparation of engineering drawings meeting DOD-D-1000. The Ordering Data sheet is provided as an attachment to the CDRL.

APPENDIX I

ENGINEERING DRAWINGS
DOD-D-1000B LEVEL 1

6.2.1 Procurement Requirements

(a) Drawings, Engineering and Associated Lists, DOD-D-1000B.

(b) All drawings to be Level 1 drawings.

(c) The Naval Sea Systems Command Federal Supply Code for Manufacturers (53711) is to be used. Navy drawing numbers are to be used.

(d) Contact the Naval Oceans Systems Center, Code 9314 (225-2521), for drawing number assignment. Government drawings formats are to be used and furnished by the contractor. Sample formats are available.

(e) Except as noted, the requirements of DOD-STD-100 do not apply.

(f) Data Item Description DI-E-7031 applies.

(g) The metric system shall (or shall not) be used.

(h) Tailoring of needs is not applicable.

(i) Company standards may be used only with unlimited rights in accordance with Armed Services Procurement Regulation 7-104.9.

(j) Index Lists (ILs) are required for major configuration items.

(k) Parts lists are not required.

(l) Mono-detail and multi-detail drawings shall be used as required to clearly define and document the concept.

(m) For purposes of preliminary design review, functional block diagrams will be provided for all electronic/electrical functions. For purposes of critical design review, schematics will be furnished for all electronic circuits and assemblies.

(n) Control drawings shall not be prepared.

(o) N/A

(p) Drawing format material shall conform to that specified in DOD-STD-100.

(q) The contractor shall furnish (specify number) blueline copies of each drawing for Navy review.

(r) Microfilm aperture cards of drawings are not required.

(s) Delivery of original vellums is not required.

(t) N/A

(u) Delivery of original drawing vellums shall be in accordance with CDRL item number (specify).

APPENDIX J

"ORDERING DATA" FOR LEVEL 2 ENGINEERING DRAWINGS

NOTE: "Ordering Data" are those supplementary procurement requirements data (DOD-D-1000B, Paragraph 6.2.1) which must be furnished to the supplier when specifying the preparation of engineering drawings meeting DOD-D-1000. The Ordering Data sheet is provided as an attachment to the CDRL.

APPENDIX J

ENGINEERING DRAWINGS
DOD-D-1000B LEVEL 2

6.2.1 Procurement Requirements

(a) Drawings, Engineering and Associated Lists, DOD-D-1000B.

(b) All drawings to be Level 2 drawings.

(c) The Naval Sea Systems Command Federal Supply Code for Manufacturers (53711) is to be used. Navy drawing numbers are to be used.

(d) Contact the Naval Ocean Systems Center, Code 9314 (225-2521), for drawing number assignment. Government drawing formats are to be used and furnished by the contractor. Sample formats are available.

(e) The requirements of DOD-STD-100 shall be applied in their entirety.

(f) Data Item Description DI-E-7031 applies.

(g) The metric system shall (or shall not) be used.

(h) Tailoring of documentation requirements for cost saving is encouraged. Tailoring possibilities include:

(1) Use of multi-detail drawings for depicting all inseparable (riveted, welded, etc.) assemblies and all assemblies which are judged to be economically nonrepairable items and are not designated spare parts.

(2) Restricting the use of geometric dimensioning and tolerancing to those features which provide an interface with spare and repair parts or system mounting or other equipment attachment interfaces.

(3) Use of integral parts lists for item (1) type assemblies.

The contractor is encouraged to consider other cost savings tailoring possibilities and to submit any such recommendations to the NAVOCEANSYSCEN for consideration.

(i) Company materials, processes and components standards shall not be used.

(j) Parts Lists (PLs) are required. Index Lists (ILs) are required for major configuration items.

(k) Parts Lists are to be prepared for all assemblies.

(l) See tailoring notes (h) above.

(m) Schematics and wiring diagrams to be furnished for all electrical/electronic assemblies.

(n) Control drawings shall be prepared as provided for by Paragraph 3.5.2 or DOD-D-1000, for all commercial components intended for use in mission-critical applications where component failure would result in failure of the system to operate or would result in a significant reduction in performance or capability or would result in a hazardous condition for personnel. Control drawings are not required for components where failure of such components is not considered to be mission-critical or would not result in a hazardous condition.

(o) See tailoring notes (h) above.

(p) Drawing format material shall conform to that specified in DOD-STD-100.

(q) Following independent review of the drawings by the contractor's quality assurance organization, the contractor shall furnish (specify number) blueline copies of each completed drawing for Navy review and comment. Any required changes shall be provided to the contractor for incorporation into the original drawing vellums.

(r) Microfilm aperture cards of all drawings are required at the time of delivery of the original drawing vellums.

(s) Following incorporation of the necessary changes into the original drawing vellums, the vellums shall be delivered as indicated in (u).

(t) The original drawing vellums shall be packaged in a manner that will protect them from damage.

(u) Delivery of original drawing vellums shall be in accordance with the CDRL item number (specify).

APPENDIX K

"ORDERING DATA" FOR LEVEL 3 ENGINEERING DRAWINGS

NOTE: "Ordering Data" are those supplementary procurement requirements data (DOD-D-1000 B, Paragraph 6.2.1) which must be furnished to the supplier when specifying the preparation of engineering drawings meeting DOD-D-1000. The Ordering Data Sheet is provided as an attachment to the CDRL.

APPENDIX K

ENGINEERING DRAWINGS
DOD-D-1000B LEVEL 3

6.2.1 Procurement Requirements

(a) Drawings, Engineering and Associated Lists, *DOD-D-1000B*.

(b) All drawings to be Level 3 drawings.

(c) The Naval Sea Systems Command Federal Supply Code for Manufacturers (53711) is to be used. Navy drawing numbers are to be used.

(d) Contact the Naval Ocean Systems Center, Code 9314 (225-2521), for drawing number assignment. Government drawing formats are to be used and furnished by the contractor. Sample formats are available.

(e) The requirements of DOD-STD-100 shall be applied in their entirety.

(f) Data Item Description DI-E-7031 applies.

(g) The metric system shall (or shall not) be used.

(h) Tailoring of documentation requirements does not apply.

(i) Company materials, processes and component standards shall not be used.

(j) Parts Lists (PLs) are required. Index Lists (ILs) are required for major configuration items.

(k) Parts Lists are to be prepared for all assemblies.

(l) Except for inseparable (e.g., weldments, riveted assemblies), assemblies where multi-detail drawings may be prepared, mono-detail drawings shall be prepared.

(m) Schematics and wiring diagrams to be furnished for all electrical/electronic assemblies.

(n) Control drawings shall be prepared as provided for by Paragraph 3.5.2 *of* DOD-D-1000B. All standard or modified off the shelf equipment or vendor catalog items shall be described by control drawings.

(o) Parts Lists shall be separate from the engineering drawings in all instances except special test equipment, fixtures and tools wherein integral parts lists may be utilized.

(p) Drawing format material shall conform to that specified in MIL-STD-100.

(q) Following independent review of the drawings by the contractor's quality assurance organization, the contractor shall furnish (specify number) blueline copies of each drawing for Navy review and comment. Required changes shall be provided to the contractor for incorporation into the original drawing vellums.

(r) Microfilm aperture cards of all drawings are required at the time of delivery of the original drawing vellums.

(s) Following incorporation of the necessary changes into the original drawing vellums, the vellums shall be delivered as indicated in (u).

(t) The original drawing vellums shall be packaged in a manner that will protect them from damage.

(u) Delivery of original drawing vellums shall be in accordance with CDRL item number (specify).

(v) All drawings for spare parts shall have classified characteristics in accordance with DOD-STD-2101. The note of attachment (specify a suitable note is provided in Appendix L) shall be placed on each drawing having classified characteristics.

APPENDIX L

IMPLEMENTING NOTE FOR DRAWINGS HAVING CLASSIFIED CHARACTERISTICS

The attached note is recommended for direct inclusion on drawings having classified characteristics (DOD-STD-2101). The AQLs specified in the note may be adjusted as appropriate to the equipment item. If the note is utilized it is recommended that it be preprinted on adhesive film so as to avoid having to add the note by manual methods (see Paragraph 3.1.19.1.4). It is pointed out that the information contained within the parenthesis in Paragraph e is instructional to the designer and should not be included in the note itself.

APPENDIX L

IMPLEMENTING NOTE FOR DRAWINGS HAVING CLASSIFIED CHARACTERISTICS

The following Note shall be placed on all drawings for which characteristics will be classified in accordance with DOD-STD-2101 (OS)

Verification of Classified Characteristics

The characteristics of this component/assembly shall be verified by the supplier, as follows:

a. Critical characteristics (C1, C2, etc.) shall be verified 100 percent.

b. Major characteristics (M101, M102, etc.) shall be verified on a "class" basis (AQL applies to the entire group of characteristics taken as a whole - see DOD-STD-2101, Paragraph 50.7.1). For procurement of separate items (spare parts), as a minimum, major characteristics shall be verified in accordance with MIL-STD-105, Inspection Level II, to the AQL indicated in the following table, unless otherwise specified by the procuring activity.

LOT SIZE	AQL (Applied by Class)
1 - 20 units	100 Percent Inspection
21 - 150	.65
151 and above	1.5

c. Minor characteristics (201, 202, etc.) shall be verified on an "individual" basis (AQL applies to each characteristic individually). For procurement of separate items (spare parts), as a minimum, minor characteristics shall be verified in accordance with MIL-STD-105, Inspection Level II, to the AQL indicated in the following table, unless otherwise specified by the procuring activity.

LOT SIZE	AQL (Applied Individually)
1 - 8 units	100 Percent Inspection
9 - 50	1.5
51 - 150	4.0
151 and above	6.5

d. Unclassified characteristics shall be verified in accordance with a plan established by the supplier, subject to the concurrence of the Government Representative. As a minimum, a first article sample shall be inspected for these characteristics.

e. Characteristics identified by one of the suffixes listed below shall be inspected as indicated: (instruction to drawing preparer: only those of the following which <u>apply</u> to the component/assembly need be included in the note)

D. Certified test or inspection data acceptable as verification (applies to material/process requirements)

E. Requires exceptional testing or inspection, not covered by a standard sampling plan (if this suffix is utilized on the drawing, then a note specifying the inspection or test requirements must be provided)

S. Because of the consistent nature of the characteristic, shall be verified in accordance with a plan established by the supplier, subject to the concurrence of the Government Representative (applies to features produced with very stable, hard tooling such as with die castings, forgings, and extrusions)

P. To be verified prior to assembly

V. Critical or major, as classified, when part is procured as a separate end item; minor when covered by high assembly level inspection or test

F. Designates a critical characteristic that is so classified because of effect on mission performance and has no effect on safety

L. Designates a critical characteristic that has potential hazardous or unsafe conditions for individuals during the processing of items, but would not present a safety hazard in Fleet usage.

APPENDIX M

DESCRIPTION OF QUALITY/RELIABILITY SCREENING LEVELS OF STANDARD PARTS

APPENDIX M

DESCRIPTION OF QUALITY/RELIABILITY SCREENING LEVELS OF STANDARD PARTS

Reliability screening is a testing process designed to remove from a group of parts those having inferior reliability. Such screening is accomplished by subjecting a delivered lot of parts to various electrical, thermal and environmental stresses for the purpose of making the weak ones fail. The screening process must be designed to meet the following criteria:

- o Test and stress levels must be carefully selected to fail inferior parts
- o Test must be non-destructive and non-degrading to good parts
- o Testing must be adequate to screen out all potential failure mechanisms of the parts to be screened

An effective screening program requires a detailed understanding of the materials, fabrication and packaging techniques, electrical and thermal characteristics and manufacturing tests performed on the parts to be screened. In addition, to limit costs to a reasonable level, screening should be based upon the least amount of testing required to provide a meaningful screen.

Much cost and effort has been expended by DOD agencies and industry in developing reliability screening processes and requirements for the major types of parts used in military equipment. These requirements have been detailed in the military specifications for these parts.

There are three different ways in which the reliability screening levels (also referred to as quality or product assurance levels) are specified for three distinct categories of military parts:

1. Screened military grade active and passive electrical parts (e.g., relays, coils, connectors, resistors and capacitors) are procurable to Established Reliability (ER) Military Specifications categorized as to ER failure rate level (L through T).

2. Screened military grade semiconductor devices are procurable to MIL-S-19500 and its detailed slash sheets and are categorized as JAN, JANTX, JANTXV and JANS screening levels.

3. Screened military grade microcircuits are procurable to MIL-M-38510, are labeled JAN and categorized as to screening class (i.e., S, B or C).

Commercial grade, military grade and military ER and JAN grade parts are generally physically and functionally interchangeable with the basic magnitudes. ER and JAN parts have been screened per Military Test Standards as required by the specific parts/military specifications and are certified to these specifications by government inspectors. These inspectors monitor and periodically survey and requalify these manufacturers to assure that the high reliability levels of the parts are maintained from lot to lot.

In addition to the military grade ER and JAN parts there are various so-called "vendor equivalents." These parts have been subjected to similar screening tests as those required by the ER or JAN military specifications, but do not meet the full requirements of the ER or JAN military specifications. Such vendor equivalents exhibit lower failure rates than their commercial counterparts and sometimes those of standard military parts. The screening requirements and failure rate levels of ER passive parts and JAN semiconductors and microcircuits are discussed in detail below.

A. Established Reliability (ER) Active/Passive Electrical Components

ER passive electrical parts are procurable in accordance with ER Military Specifications to various failure rate levels from manufacturers qualified and certified to those levels by government inspectors. Such manufacturers are listed on Qualified Parts Lists (QPLs). ER specifications presently exist for many types of capacitors, resistors, relays and RF coils and are presently being developed for other part types.

ER parts procured to these ER military specifications exhibit failure rates demonstrated under the controlled test conditions specified in these specifications. These failure rates are expressed as percent failures per thousand hours (percent/1,000 hrs). The failure rate levels usually* provided for by these ER military specifications are:

MIL Symbol	Failure Rate (% Failures/1,000 hrs)
L	2.0
M	1.0
P	0.1
R	0.01
S	0.001
T	0.0001

Parts procured to ER military specfications are also subjected to special process controls, lot acceptance testing, screening and extended life tests.

Manufacturers of ER parts must establish and implement a reliability assurance program in accordance with MIL-STD-790 that is evaluated and monitored by a government qualifying activity. This reliability assurance program requires an approved program plan, test, calibration and failure analysis facilities, training program, failure reporting, analysis and corrective action system, maintenance of material, process and failure analysis records, traceability, controlled storage, and reporting of test results to maintain listing on the QPL.

*Failure rate levels vary for different parts and different ER specifications; e.g., "L" level failure rate for MIL-C-39022 capacitors is 5.0 percent per 1,000 hours.

ER components are 100 percent screened in accordance with the requirements of the individual ER and military specification which imposes applicable test methods and conditions of MIL-STD-202.

Failure rates and failure rate levels of ER parts are statistically established during life testing at 60 percent or 90 percent confidence levels (as required in the ER part military specifications) and in accordance with failure rate sampling plans and procedures of MIL-STD-690. These failure rates are established for laboratory conditions at <u>rated</u> electrical stress. Failure rate levels at <u>derated</u> application stress levels and actual equipment environments can be estimated using MIL-HDBK-217. <u>Parts with failure rate levels of P or better (i.e., R, S or T) should be used in the design of military equipment when available.</u>

B. <u>JAN, JANTX, JANTXV and JANS Semiconductors</u>

Military grade high reliability screened semiconductors are procurable in accordance with MIL-S-19500 and designated as JAN, JANTX, JANTXV and JANS quality levels depending upon the type and amount of screening performed on the semiconductor. The prefix JAN of a semiconductor type designation refers to the military standardization program for semiconductors. These semiconductors have been tested and have passed the minimum qualification tests specified by MIL-S-19500. The TX suffix to JAN designates "Testing Extra." JANTX parts, in addition to JAN processing, undergo specific process and power conditioning tests on a 100 percent basis (depending upon the detail specification) in addition to the JAN sampling tests, to enable further elimination of defective parts. JANTXV quality level semiconductors require all testing performed on JANTX semiconductor devices plus an internal visual PRECAP inspection which further eliminates defective parts and provides greater reliability in the surviving lot. JANS quality level semiconductors, while requiring all the tests performed on JANTXV parts, also requires Particle Impact Noise Detection (PIND) testing, failure analysis, serialization and traceability to a wafer lot.

The sampling procedure and acceptance requirement for JAN testing is in accordance with the Lot Tolerance Percent Defective (LTPD) as defined in MIL-STD-105 and as specified in the semiconductor detailed specification. Test methods used in screening semiconductors are in accordance with MIL-STD-750 for tests specified in the detail specifications.

Failure rates for semiconductors are determined in accordance with the procedures of MIL-HDBK-217.

Relative failure rate (FR) multipliers for various types of semiconductors for a given temperature and electrical stress level and based upon JAN as 1.0 are shown in Table 1 (JANS being the most reliable and "commercial" being the least reliable).

These FR multipliers are used in the formulation of semiconductor failure rates per MIL-HDBK-217. <u>JANTX, JANTXV or JANS level semiconductors are recommended for use in the design of military equipment.</u>

Screening Level	All Semiconductors Except Microwave	Microwave Detectors and Mixers (Si & Ge)
JANS	.05	.05
JANTXV	.1	.1
JANTX	.2	.3
JAN	1.0	1.0
Lower*	5.0	5.0

*Hermetic packaged devices

Table 1. Relative failure rate differences.

C. Quality/Reliability Levels of Microcircuits

High quality level microcircuits should be procured per MIL-M-38510. This specification establishes the design, quality, reliability assurance and vendor qualification and certification requirements for monolithic, multichip and hybrid microcircuits. There are three classes of screening provided for military JAN microcircuits: MIL-M-38510 JAN Classes S, B and C with S being the highest quality level and C the lowest quality level. Only microcircuits procured per MIL-M-38510 may have the "JAN" designation. The MIL-M-38510 Class S, B and C microcircuits require screening tests in accordance with Method 5004 (for monolithic) or Method 5008 (for hybrid) of MIL-STD-883 Class S, B and C, respectively, (except for interim electrical parameter testing). Manufacturers of microcircuits per Classes S, B and C of MIL-M-38510 must meet specific qualification requirements to acquire and maintain listing on the QPL. This qualification requires a manufacturer certification (including a government approved Product Assurance Program Plan), production line certification and qualification and quality conformance inspection testing per Method 5005 (for monolithic) or Method 5008 (for hybrid microcircuits) of MIL-STD-883.

Many microcircuits are procured to MIL-STD-883 Class S, B or C screening. These devices may have been subjected to the tests of MIL-STD-883 Method 5004 (for monolithic) or Method 5008 (for hybrid microcircuits) but have not had the in-process controls required by MIL-M-38510 and generally exhibit higher failure rates than MIL-M-38510. Besides the MIL-M-38510 Class S, B and C of MIL-STD-883 Method 5004 (for monolithic) or Method 5008 (for hybrid) screened microcircuits, there are various vendor equivalents, "vendor classes" and lower grade commercial parts which exhibit much higher failure rates than both the MIL-M-38510 and MIL-STD-883 Method (for monolithic) or Method 5008 (for hybrid) screened microcircuits. MIL-M-38510 Class B quality levels are recommended for all microcircuits used in the design of military equipment.

Relative failure rate multiplying factors also called "Quality Factors" (π_Q) for various quality grades of microcircuits are listed in Table 2. In addition to quality factor failure rate multipliers, it has been found that an independent quality factor based upon the length of continuous production has significant effects on microcircuit failure rates. These independent quality factors are called "Learning Factors (π_L)." Information on microcircuit Learning Factor failure rate multipliers can be obtained from NAVSEA 0967-LP-597-1011, "Parts Application from Reliability Information Manual for Navy Electronic Equipment."

Electrical performance tests for testing various types of microcircuits are specified in the detailed microcircuit military specification and are performed in accordance with the applicable test methods of MIL-STD-883.

Quality Level	Description	π_Q
S	Procured in full accordance with MIL-M-38510, Class S requirements.	1
B	Procured in full accordance with MIL-M-38510, Class B requirements.	2
B-1	Procured to screening requirements of MIL-STD-883, Method 5004, Class B, and in accordance with the electrical requirements of MIL-M-38510 "slash" sheet or vendor or contractor electrical parameters. The device must be qualified to requirements of MIL-STD-883, Method 5005, Class B. No waivers are allowed.	5
B-2	Procured to vendor's equivalent of screening requirements of MIL-STD-883, Method 5004, Class B, and in accordance with vendor's electrical parameters. Vendor waives certain requirements of MIL-STD-883, Method 5004, Class B.	10
C	Procured in full accordance with MIL-M-38510, Class C requirements.	16
C-1	Procured to screening requirements of MIL-STD-883, Method 5004, Class C and in accordance with the electrical requirements of MIL-M-38510 "slash" sheet or vendor or contractor electrical specification. The device must be qualified to requirements of MIL-STD-883, Method 5005, Class C. No waivers are allowed.	90
D	Commercial (or non-mil standard) part, hermetically sealed, with no screening beyond the manufacturer's regular quality assurance practices.	150
D-1	Commercial (or non-mil standard) part, packaged or sealed with organic materials (e.g., epoxy, silicone or phenolic).	

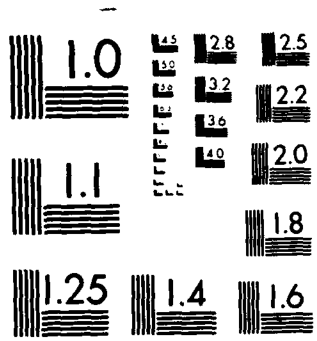
Table 2a. Microcircuit quality factors/failure rate multipliers for monolithic microcircuits.

AD-A126 678 PRODUCT ASSURANCE REQUIREMENTS GUIDE FOR NAVAL OCEAN SYSTEMS CENTER PROJECTS(U) NAVAL OCEAN SYSTEMS CENTER SAN DIEGO CA 21 DEC 82 NOSC/TD-432 4/5

UNCLASSIFIED F/G 5/1 NL

END
DATE
FILMED
6-83
DTIC

Cont



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Quality* Level	Description	π_Q
B	Procured to the Class B requirements of MIL-STD-883, Method 5008 and Appendix G of MIL-M-38510 or MIL-STD-883, Methods 5004 and 5005 and MIL-M-38510.	1.0
D	Commercial part, hermetically sealed, with no screening beyond manufacturer's normal quality assurance practices.	60.0

*Classes S and C requirements not applicable to hybrid microcircuits.

Table 2b. Quality factors/failure rate multipliers for hybrid microcircuits.

APPENDIX N

COMMERCIAL EQUIPMENT
SELECTION PROGRAM

APPENDIX N

COMMERCIAL EQUIPMENT SELECTION PROGRAM

A program for the identification and selection of suitable commercial equipment shall be established by the contractor whenever it is anticipated that commercial equipment will be incorporated into the system design. The goal of the program is to select those commercial equipment items whose operational availabilty (a function of reliability and maintainability) is optimum when considered on a total life-cycle cost basis. In this program the contractor is expected to perform design analysis, hardware inspection and reliability history investigation concerning the potential equipment candidates, the results of which will be used to select the equipment items to be utilized in the design.

The various phases of the commercial equipment selection program are described here in general terms. Since the exact process of equipment selection will vary depending on the equipment type, the contractor is expected to plan the specific procedures to be followed within these guidelines.

While the conduct of the program is considered to be the responsibility of the contractor's design organization, there must be full participation by the contractor's reliability and maintainability group as well. The reliability and maintainability group shall be required to review the program data and to concur in any recommendations for equipment selection. The NOSC project office shall review and approve all commercial equipment selections.

The contractor shall report on the progress of the program in connection with the scheduled design reviews and shall prepare interim and final reports which summarize program progress and results, in accordance with CDRL item number (specify).

The program shall include the following phases:

Phase I - Identification of potential equipment candidates. The contractor shall identify a suitable number of potential equipment candidates utilizing such sources as:

- A review of existing military systems of a similar nature
- A review of existing commercial systems of a similar nature
- A review of commercial equipment directories such as the Thomas Register, Electronics Industry Telephone Directory, Directory of Engineering Document Sources, Defense Marketing Services and VSMF (Visual Search Microfilm)

Phase II - Screening of potential equipment candidates. Following the identification of potential equipment candidates, the contractor shall perform a survey of the manufacturer's technical data sheets and specifications. The

survey should disclose which of the potential candidate equipments appear to meet the system requirements or could be readily modified to meet those requirements. Of the candidate equipments which have been so screened, a small number should be selected which the designer and reliability team members consider to be the most likely to meet the requirements.

Phase III - Review of most promising equipment candidates. Following the identification of the few most promising equipment candidates, to the maximum possible extent, the contractor shall obtain the following indicated data concerning the candidates and examine the data as described.

a. Review of equipment schematic. The equipment schematic shall be reviewed to determine: the reasonableness of the design approach, the relative reliability (as compared to the other candidates) of the design including the existence of redundancy for critical functions, the type and quality of components utilized, the component stress levels and the derating practices followed by the designer (to be determined on a sample basis).

b. Review of equipment detail design disclosures (i.e., construction drawings). The detailed equipment drawings, which are likely to be proprietary but nonetheless should be reviewed if at all possible (at the equipment supplier's own facility, if necessary), shall be reviewed for the following features:

(1) Safety. The design shall be reviewed for the existence of fail-safe features for safety of personnel during the installation, operation, maintenance and repair (to the extent to be performed by the fleet) or interchanging of the equipment. Additionally, the design shall be reviewed for its extent of compliance with requirement 1 of MIL-STD-454 as compared to the other candidate equipments.

(2) Use of flammable materials. The design shall be reviewed to determine the extent to which flammable materials are utilized in the design, particularly for electronic, electrical or mechanical insulation purposes.

(3) Thermal design considerations. The design shall be reviewed to determine the extent to which thermal protection has been employed through the use of insulation, forced cooling, heat sinking, etc.

(4) Electrical overload protection. The design shall be reviewed to determine the extent to which electrical overload protection has been employed through the use of fuses, circuit breakers, time-delays, cutouts or circuit interruption devices and the protection of critical networks, such as pulse forming networks.

(5) Printed wiring board layout. The design shall be reviewed to determine the extent to which the printed wiring board layouts seem to comply with MIL-P-55110 as compared to the other candidate equipments.

(6) Internal wiring, cable design and connector selection. The design shall be reviewed to determine the reasonableness of the internal

wiring, the exterior and interior cable design and the adequacy of connectors. Requirements 10, 65, 66, 69 and 71 of MIL-STD-454 shall be used for guidance.

(7) Soldering. The design shall be reviewed to determine the extent to which the soldering requirements (if specified on the construction drawings) comply with Requirement 5 of MIL-STD-454.

(8) Workmanship. The design shall be reviewed to determine the extent to which the general workmanship requirements (if specified on the construction drawings) comply with Requirement 9 of MIL-STD-454. Special cleaning or protective measures invoked, such as conformal coating, should be noted.

(9) Vibration/shock susceptibility. The design shall be reviewed to determine whether the equipment appears to be susceptible to damage as a result of vibration and shock at the levels anticipated for the system.

(10) Human engineering. The design shall be reviewed to determine its adequacy from a human engineering standpoint. MIL-STD-1472 shall be used as a guide.

(11) Other design features. Other features of the design (bearings, batteries, controls, motors, gears, cams, construction details, etc.) should be evaluated as to their adequacy. MIL-STD-454 shall be utilized as a guideline.

(12) Maintainability. The design shall be reviewed to determine its ease of maintenance with regards to those maintenance functions which logically would be performed by Fleet personnel. Special maintenance provisions (e.g., easily replaced modules) should be noted.

c. Review of equipment technical manuals. The technical or operation manuals for the candidate equipment shall be reviewed to determine the relative difficulty of operating and maintaining the equipment (anticipated operational or intermediate level maintenance) as compared to the other candidates. The completeness and clarity of the manual shall be evaluated as well.

d. Review of operational reliability and maintenance data. An aggressive effort shall be made to determine what has been the operational reliability of the candidate equipments. Such data may be obtained from user activities (military and commercial) and from the equipment supplier. Maintenance information, including the frequency and the severity of repairs and the repair turn-around-time (presumably by the supplier) should be obtained if possible. Data regarding the overall expected life (time and operating hours) of the equipment should be obtained as well.

Upon completion of the reviews of a, b, c and d above, the contractor shall present the collected data in a matrix chart which compares the candidate equipments. Detailed notes should accompany the chart where necessary to provide additional descriptive information. Where absolute statements of

quality cannot be made (e.g., assessments of inherent reliability or environmental survivability), then relative figures of merit should be used. Finally, an estimate of overall life-cycle cost shall be made of each of the competing candidates based on the anticipated service life of the system. A copy of this chart shall be included in the final program status report. From the above data, the contractor shall select the most promising equipment for further evaluation; two may be selected if there is no clear choice between the top contenders. If the equipment has multi-application use in the system or other factors justify this action, a third candidate may be selected for further evaluation.

Phase IV - Selection of best candidate equipment. The selection of the best (highest availability and lowest overall life cycle cost) candidate equipment will be determined based on a physical and functional examination of a sample production unit along with verification of its environmental survivability. The sample production unit shall be subjected to the following:

a. Functional performance verification. The sample production equipment shall be tested, in a benign environment, to determine if the system performance requirements will be met. If modifications are required, such changes should have been made in advance, preferably by the equipment supplier. Variables data shall be taken and recorded.

b. Physical examination. The sample equipment shall be examined, internally and externally, to determine the following:

(1) Overall design and construction details. The sample unit shall be examined to determine the existence of design or construction features that indicate potential safety, reliability, operating (including human engineering), maintenance or environmental susceptibility problems. The examination shall include a verification of the design features identified during the review of the detailed design disclosures. MIL-STD-454 shall be used for guidance.

(2) Conformance to the detailed design disclosures (construction drawings). Without resorting to major disassembly which might affect unit performance, the sample unit shall be examined to determine whether the details of construction and assembly reflect the detail design disclosures.

(3) Workmanship and cleanliness. The sample unit shall be examined to determine the quality of the workmanship employed in the construction and assembly and whether the unit is free from foreign material, soldering flux, solder balls, etc. Requirements 5 and 9 shall be used for guidance and the extent to which the equipment appears to conform to these requirements shall be noted.

c. Environmental evaluation. Upon verification of satisfactory functional performance following the physical examination, the sample unit shall be tested at the various operating environments established in the system development specification. The sequence of testing to these environments and the conditions under which that testing will be performed shall be proposed by

the contractor and approved by the NOSC project manager. To the maximum practical extent, the environmental evaluation should be conducted under the same conditions as anticipated in service use. Variables performance data shall be recorded and compared to the previous performance test results.

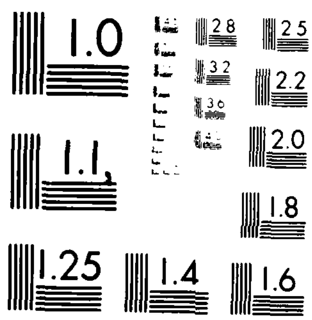
d. Post environmental evaluation inspection. Following the environmental evaluation, the sample unit shall be examined, internally and externally, for looseness of parts, damage and any observable incipient failure modes. Any previously suspected marginal design features (e.g., component overstress conditions) should be investigated further at this time. Following the inspection, additional environmental testing or life testing may be performed if considered to be appropriate. An analysis of any performance parameter drift observed during environmental testing should be made to determine its potential effect on system performance.

AD-A126 678 PRODUCT ASSURANCE REQUIREMENTS GUIDE FOR NAVAL OCEAN SYSTEMS CENTER PROJECTS(U) NAVAL OCEAN SYSTEMS CENTER SAN DIEGO CA 21 DEC 82 NOSC/TD-432

5/5

UNCLASSIFIED F/G 5/1 NL

END
DATE
FILMED
9-83
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS

SUPPLEMENTARY

INFORMATION

AD-A126678

NAVAL OCEAN SYSTEMS CENTER
SAN DIEGO, CALIFORNIA 92152

20 July 1983

NOSC TD 432
PRODUCT ASSURANCE REQUIREMENTS GUIDE FOR NAVAL OCEAN SYSTEMS CENTER PROJECTS

By Product Assuranc Division, Code 931
Dated 21 December 1982

LITERATURE CHANGES

1. Replace pages iii-iv, v-vi, vii-viii, ix-x, 71-72, with the attached new pages of the copy or copies of this report held by your code or organization.

CONTENTS

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

---

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

---

*Requirement expressed in language suitable for direct inclusion in a contract Statement of Work

APPENDICES

TABLES

supportability (see Paragraph 1.4 - Definitions). To assist in making reliability-maintainability-supportability trade-off decisions, an availability program is established which recognizes this relationship and provides a measure of achievement. This program should be integrated and conducted in conjunction with the reliability and maintainability evaluation and, when conducted by a contractor, should be reported as part of the reliability program status report.

NAVMATINST 3000.2 "Operational Availability of Weapon Systems and Equipments" establishes the operational availability (A_o) as the primary measurement of material readiness for Navy weapons systems and equipment. NAVMATINST 3000.2 also provides policy relative to the operational availability objectives and provides methods for calculation.

3.1.15.4 Reliability/Maintainability Activities During Various Program Phases

Planning consists of identifying desired goals and then establishing the best course of action to achieve those goals. R&M planning is not necessarily a separate activity, but is an effort which must be integrated into the overall planning for the system. In the conceptual phase, for example, the choice of system design alternatives must include their potential reliability and maintainability and attendant support costs in order to select the most cost-effective system alternative. In later development stages, R&M estimates are needed as inputs for system support planning for spare parts, depot facilities, training, etc. Hence, R&M is a key element in overall program planning and from this planning should emerge a set of realistic R&M objectives.

From the R&M planning viewpoint, the selection of a reliability/maintainability conscious development contractor is crucial to the success of the project, particularly with regard to full-scale development. Typically, the selection of such a contractor is a difficult and time consuming task, particularly with the larger, more complex systems where the contractors' proposals, submitted in response to the RFP, can comprise several hundred pages. The task in proposal evaluation is to consider the particular aspects, in this case R&M, of each proposal to ensure that the bidder understands what is required of him and is both willing and able to meet those requirements.

The proposal is the first opportunity where a prospective contractor may seek to obtain relaxation of the R&M requirements, often through the very subtle use of words and R&M jargon which, to the non-specialist, seem to promise more than they actually do. Knowing the man-loading (not cost) that the contractor proposes to apply to the R&M activities provides insight as to how seriously that contractor views the requirements. This information can be provided to the technical reviewer if the requirement is expressed to the contracting office in advance. Under the working pressure of source selection, even the experienced R&M engineer must guard against a tendency to assume too much. Questions, to clarify proposals and later negotiations with bidders in the competitive range, must resolve any uncertainty and ensure the contractor indeed is proposing the R&M program that the Navy desires. Careful consideration of R&M during proposal evaluation and during subsequent negotiations prevents the contractor from forming the erroneous conclusion that R&M need not

be of great concern during the program and will reduce the potential for disputes later on.

The best method for putting emphasis on R&M early in the program is to require each bidder to submit a preliminary R&M program plan with his proposal for evaluation by the source evaluation team. Deficiencies in the preliminary R&M program plan then will be the subject of precontract negotiations and these deficiencies can be ironed out before a contract is signed. If properly written, the negotiated R&M program plan then can be incorporated into the contract and become the basis for contractual compliance. This precontractual approach to the R&M program plan will ensure that the R&M program gets off to a good start, with the government and the contractor having a mutual understanding of the R&M program elements and the ground rules for their accomplishment.

In the R&M program plan, the contractor defines his approach to achieving R&M requirements, his milestones and his organization. This plan is very important since it establishes the understanding between the contractor and the Navy on the R&M effort expected and provides a reference for review and control. Hence, this document must reflect the Statement of Work requirements and completely describe an adequate program to pursue them. The approved R&M program plan (preferably negotiated before contract signing) should leave no doubts about what will be accomplished.

3.1.15.4.1 Conceptual Phase

During the conceptual phase, the primary reliability/maintainability objective is to review the system operational requirements to establish reliability and maintainability goals. Plans are developed during this phase primarily to assure that the reliability and maintainability goals are compatible with the system design concept. Where the equipment design concept is well defined, predictions are made based on historical equipment level experience data. These first estimates will begin the R&M planning activity, but the estimates must be modified repeatedly and refined as more data become available in later phases.

After preliminary system tradeoffs are made and preliminary R&M objectives are set, the next task is to prepare the overall program management plan.

The program management plan (PMP) is the master plan for the achievement of the overall program objectives. While most R&M activities will not occur until later, <u>R&M planning in the PMP document should provide for</u>:

a. Definition and refinement of realistic quantitative R&M requirements to be finally demonstrated in the full-scale development tests

b. Parts selection using military standard parts to the maximum extent possible

c. Tracking R&M progress throughout the program to provide a continual measure of achieved, versus required, R&M